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MAY 1956 VOL. LI. NO. 5

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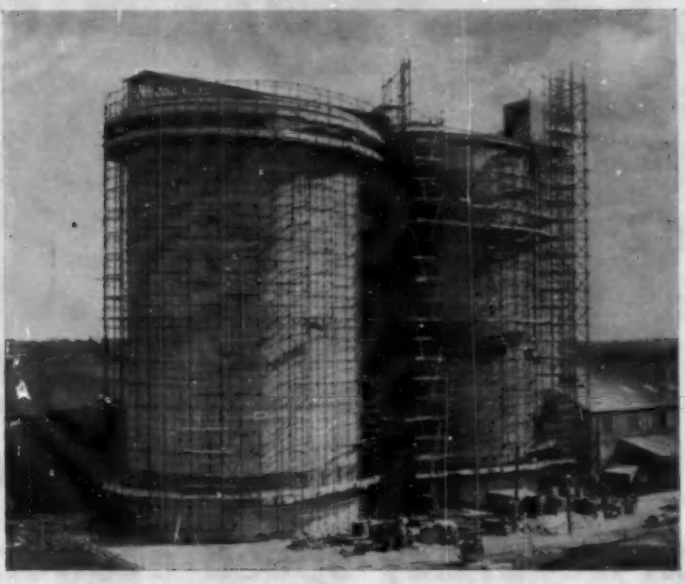
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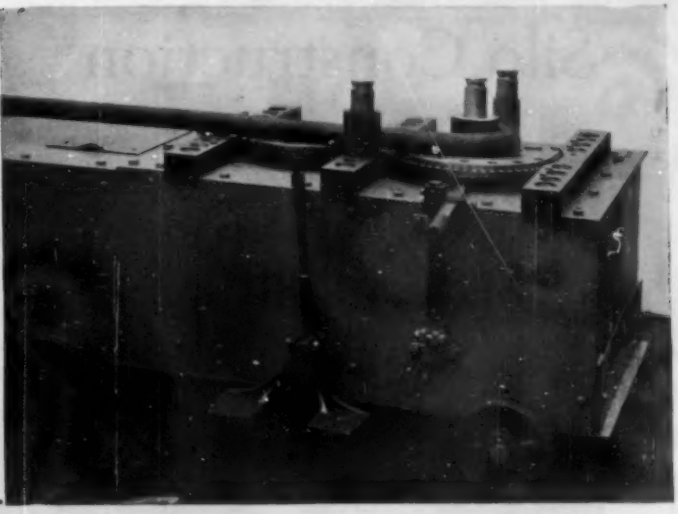
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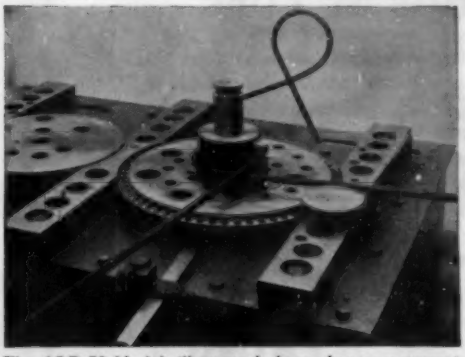
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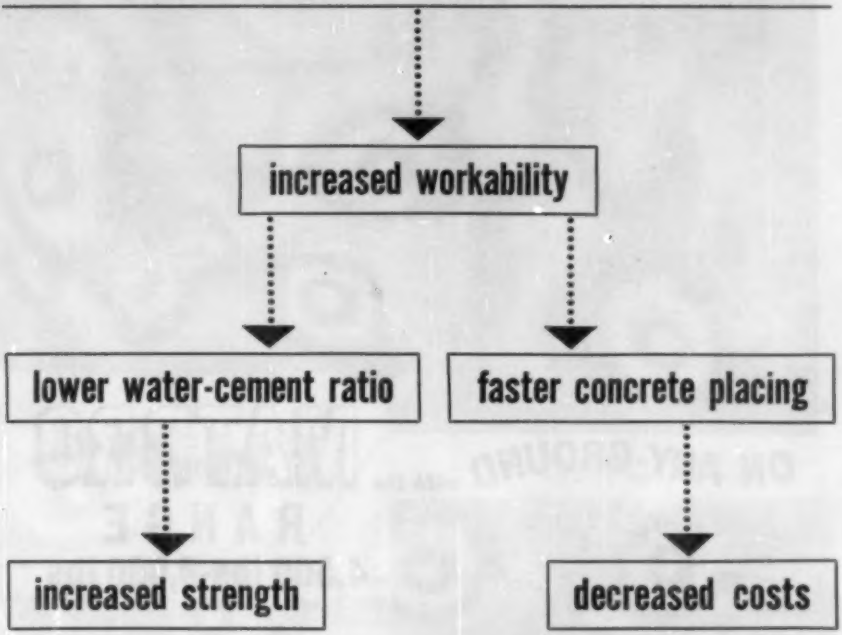
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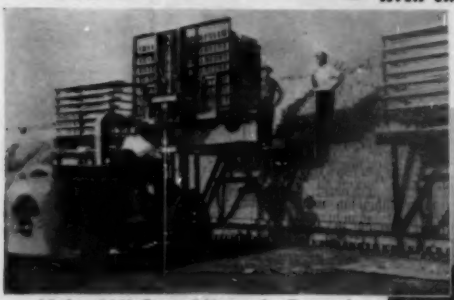
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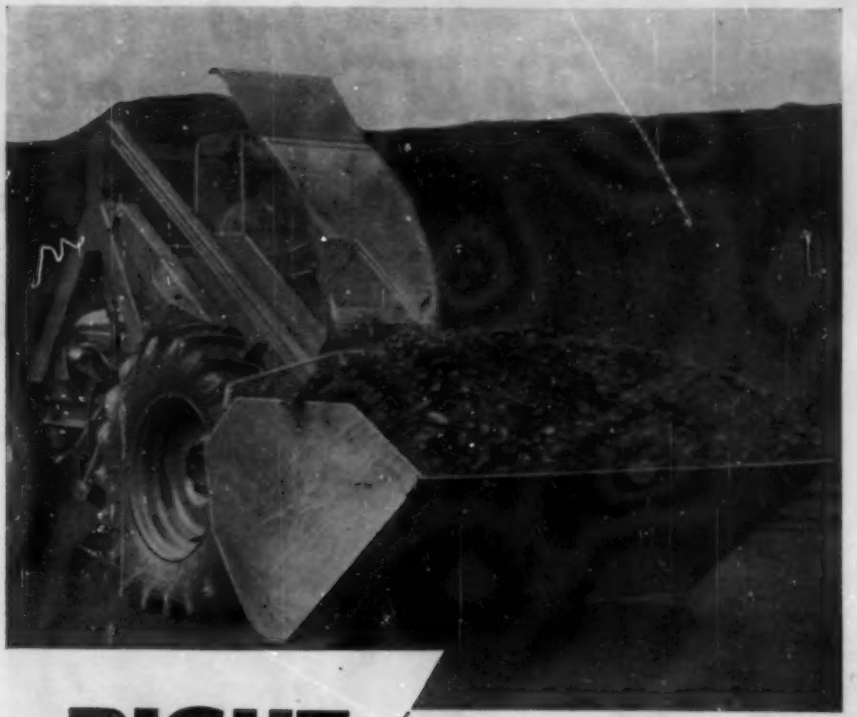
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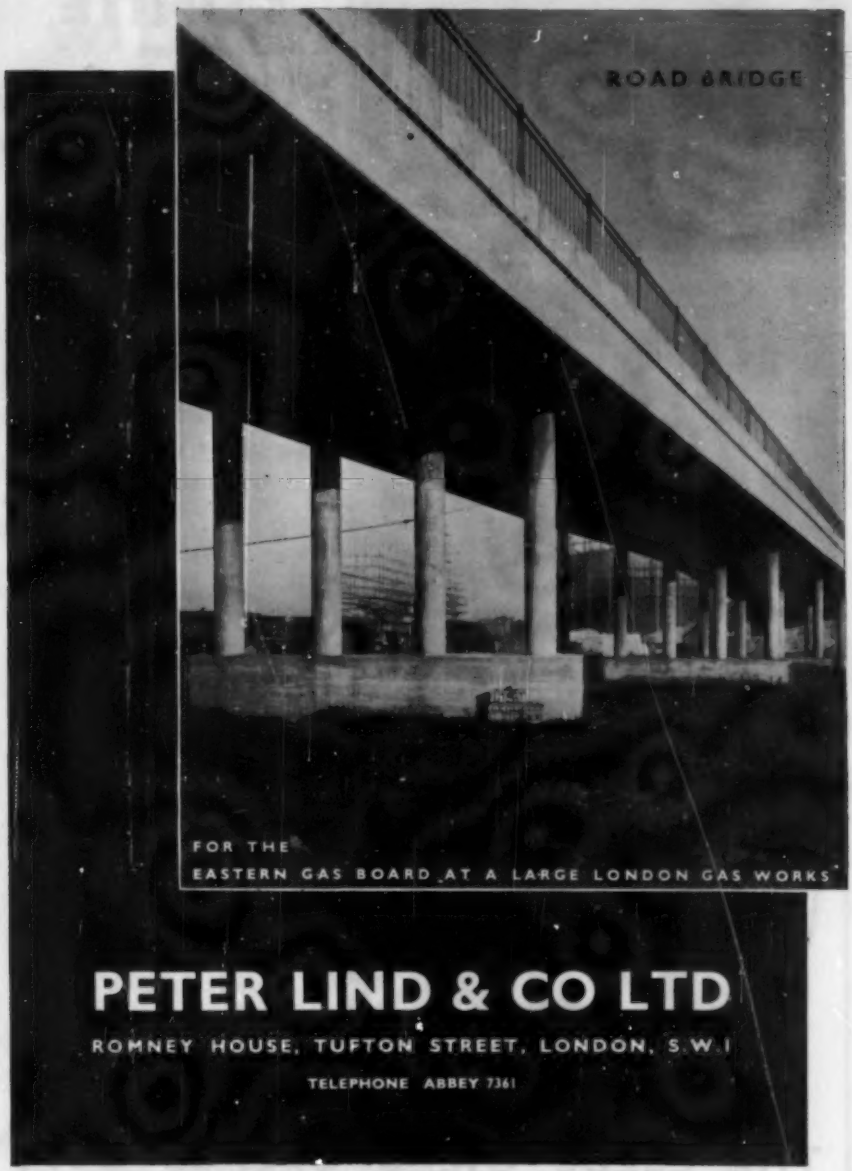
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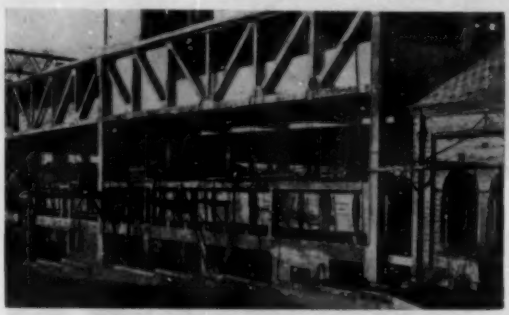
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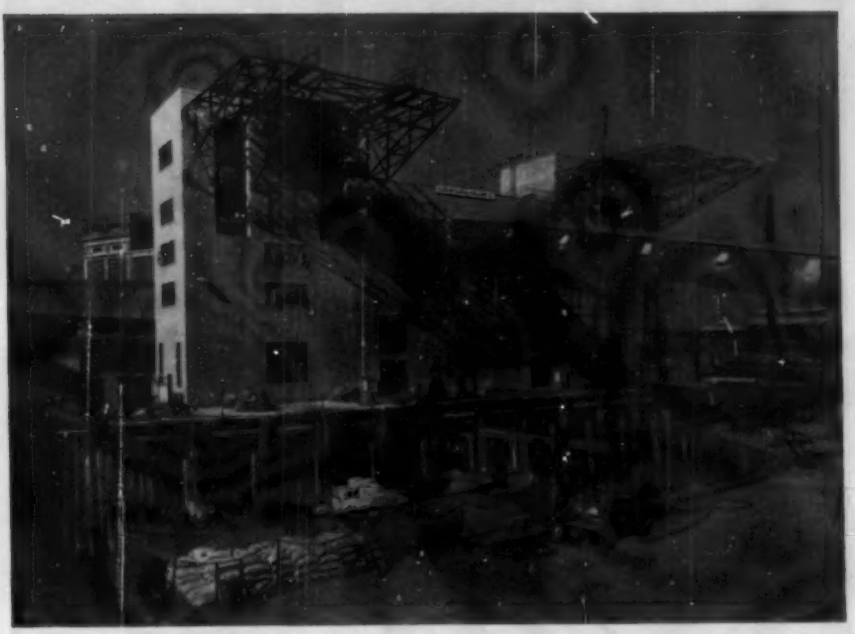
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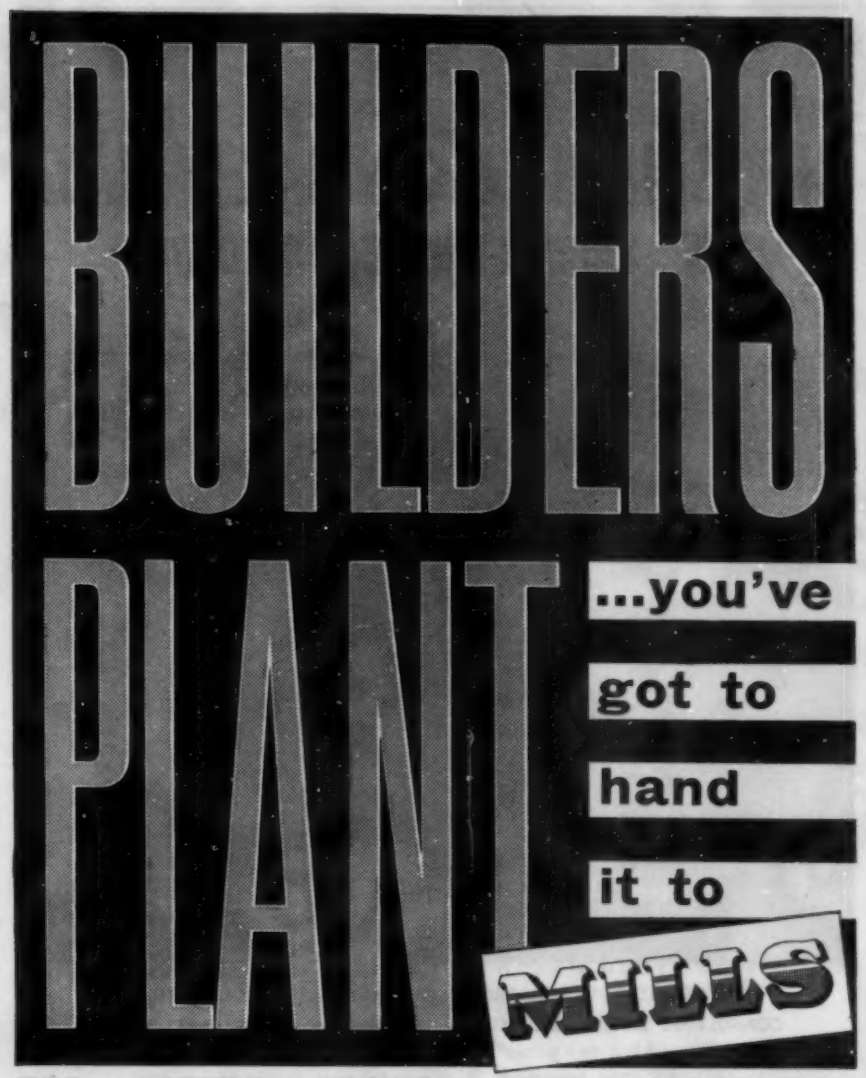
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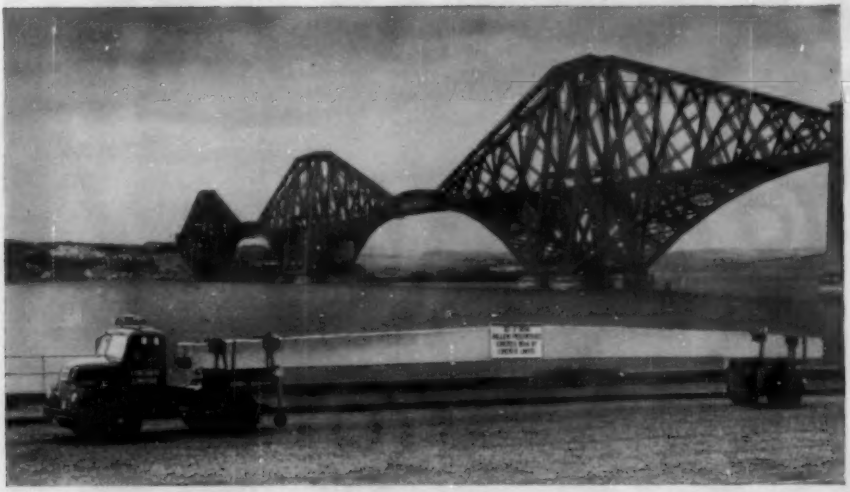
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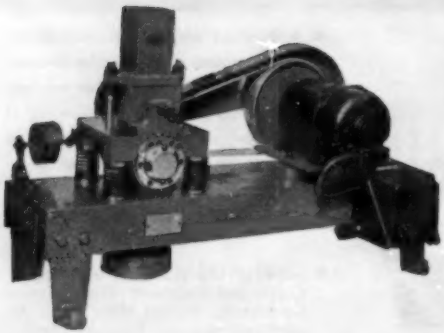
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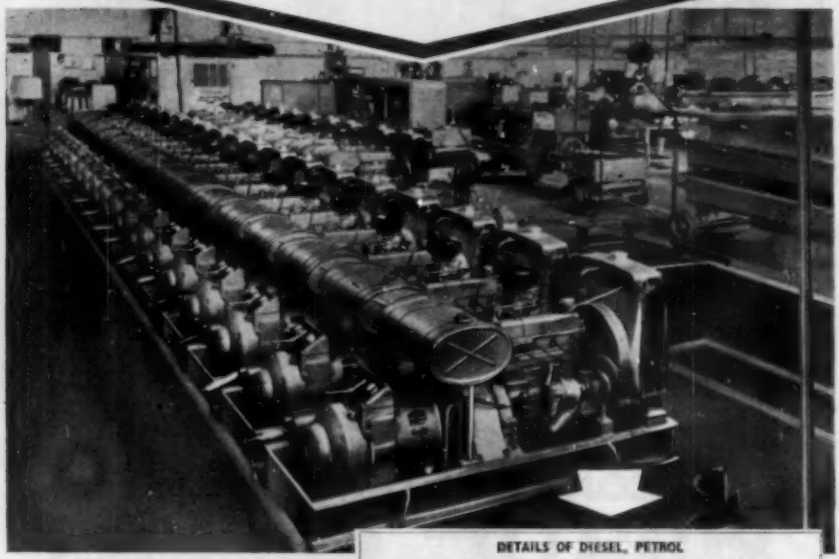
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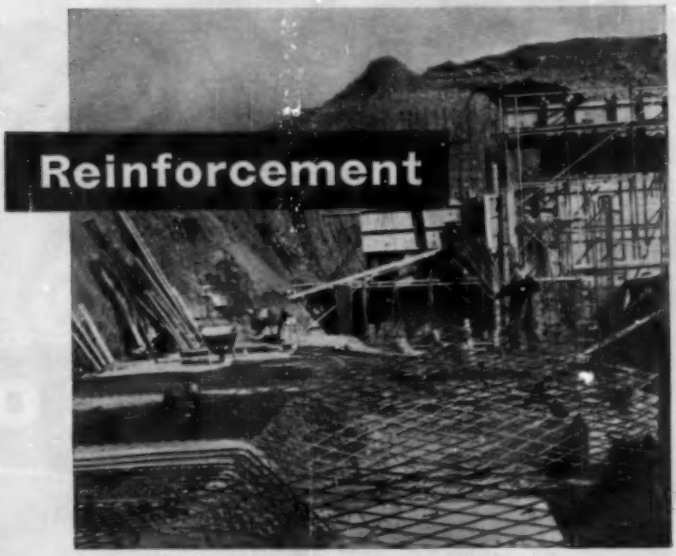
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BORE MM.	63·5	79·37	73·31	100	95	100	100	100
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CAPACITY CC.	1172	1508	2262	3610	3260	3610	3610	3610
B.H.P. @ 1000 R.P.M.	—	—	—	—	24·0	23·75	23·0	—
1500 ,,	11·25	16·0	24·0	42·5	34·5	32·75	34·0	37·5
1600 ,,	12·0	17·0	26·0	45·0	35·5	34·0	36·0	40·0
1800 ,,	13·75	19·5	30·0	53·0	—	—	38·0	44·5
2000 ,,	15·5	21·75	33·5	54·0	—	—	—	49·0
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McCalls " MATOBAR " Fabric was used in this traffic " Channelizer " constructed for the Montreal City Planning Department. The junction is at Pie IX Boulevard and Sherbrooke Street East, Montreal P.Q.

Photograph by courtesy of "The Gazette"— Montreal

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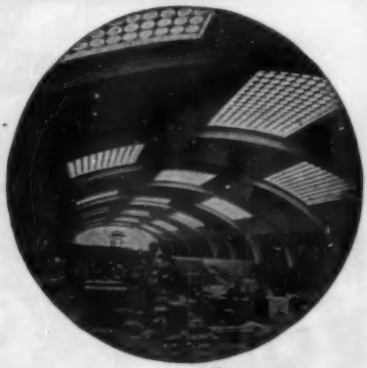
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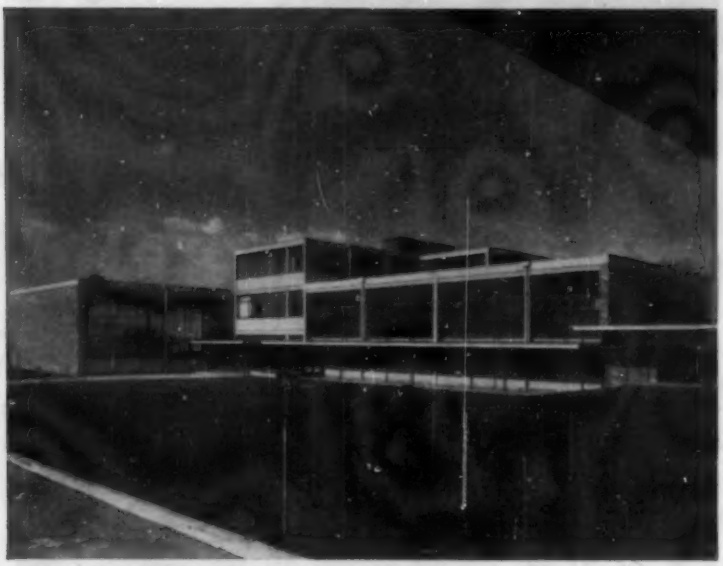
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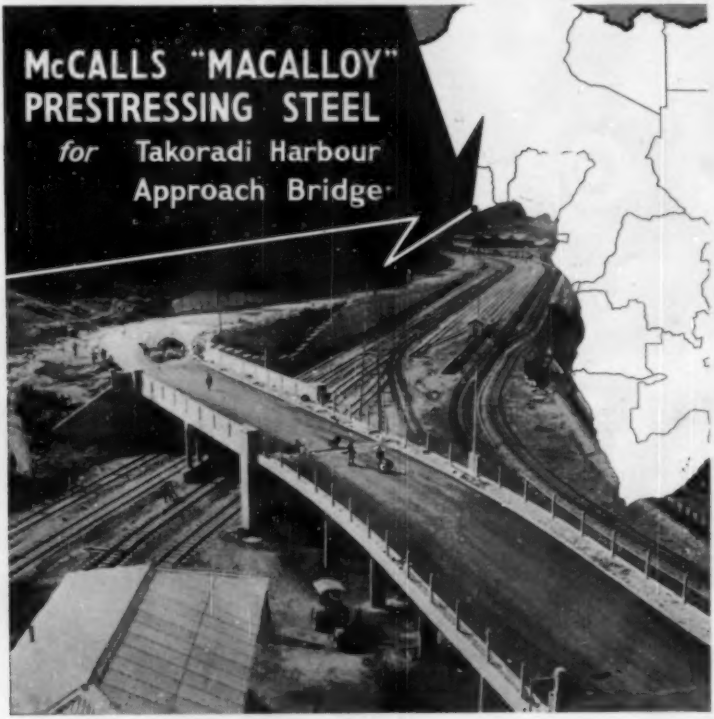
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The photograph shows a prestressed concrete road bridge over the railway yard at Takoradi Harbour extensions, Gold Coast Colony. Designed by Rendel, Palmer and Tritton, Consulting Engineers to the Gold Coast Railways and Harbours Administration, and making use of the Lee-McCall system, the bridge was constructed by Taylor Woodrow (West Africa) Ltd. The precast beams of the bridge are of 44 ft. span, each prestressed with 3–$1\frac{1}{8}$" diameter Macalloy post-tensioned bars.

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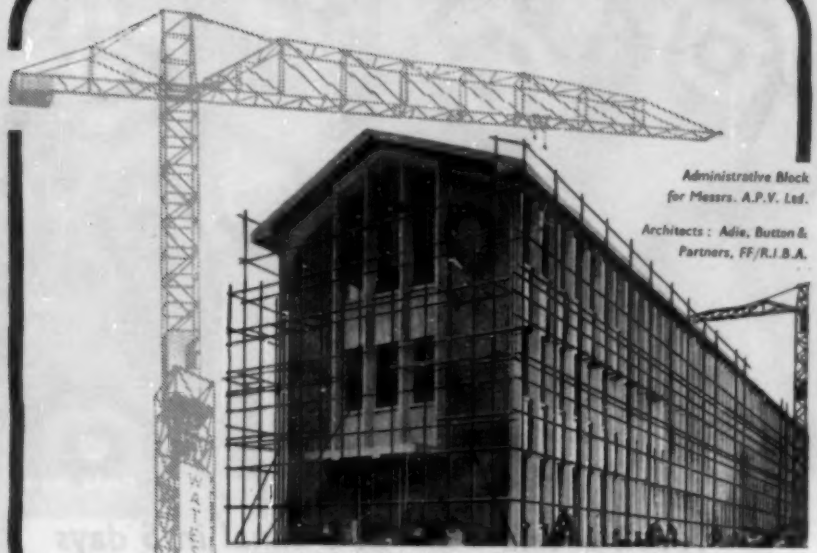
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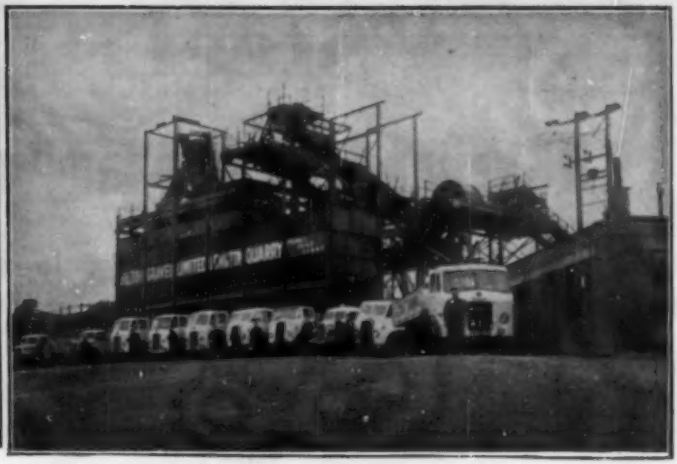
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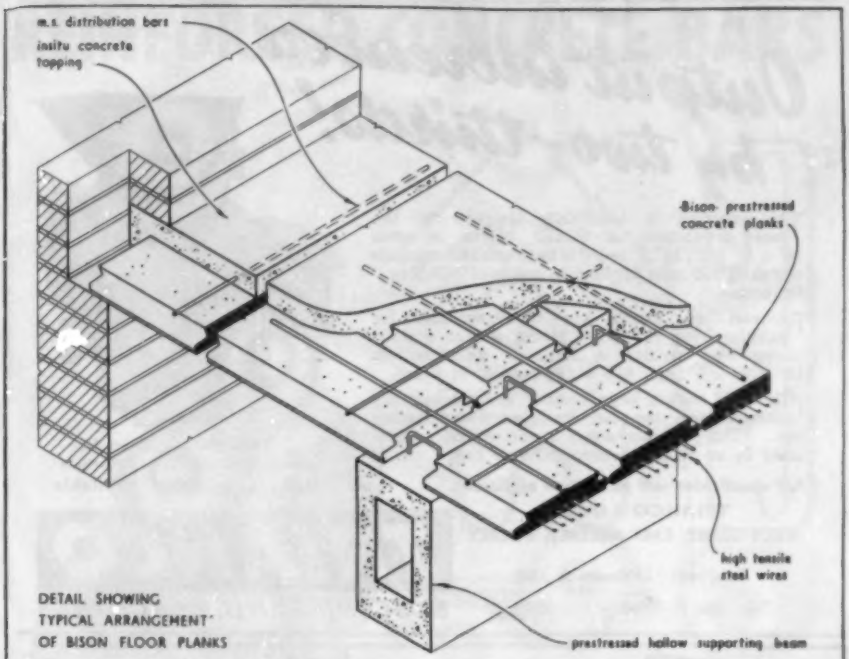
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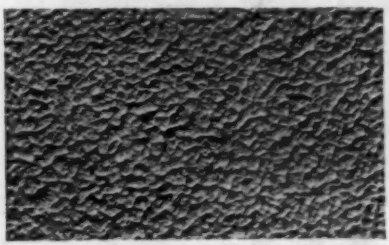
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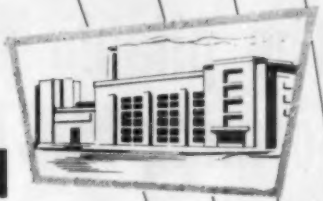
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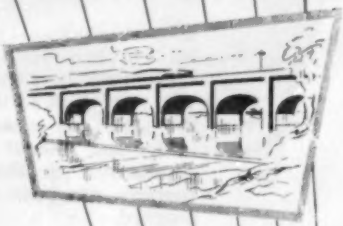
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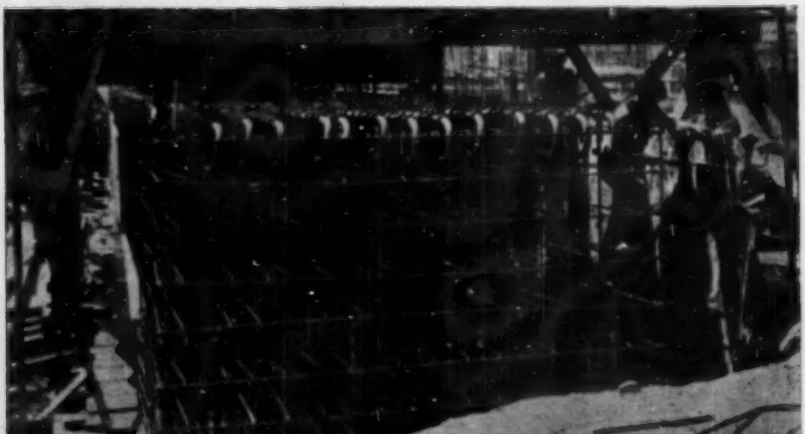
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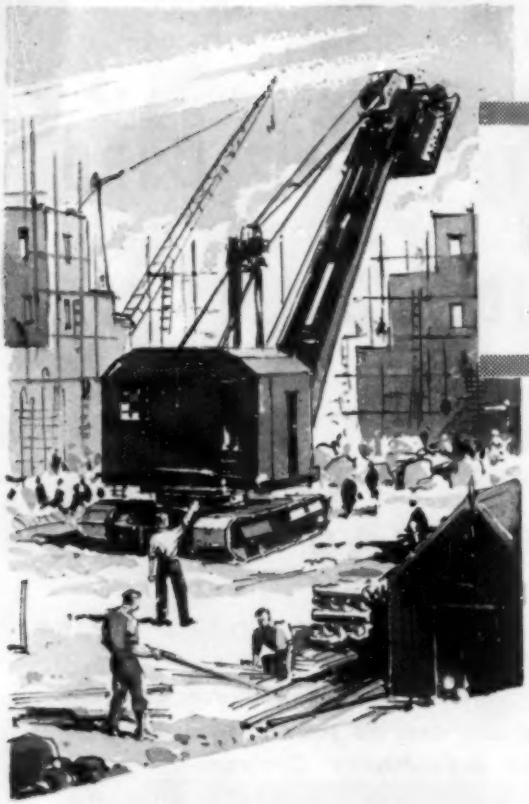
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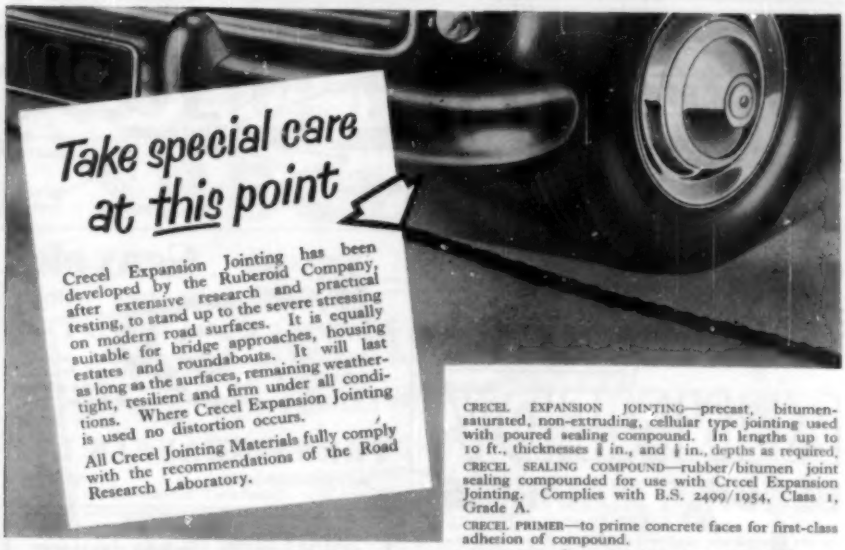
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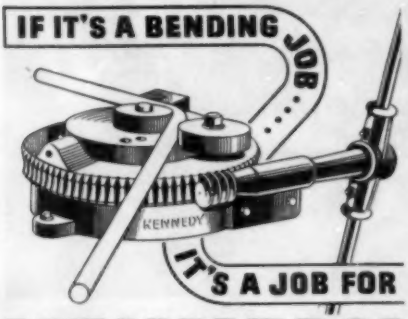
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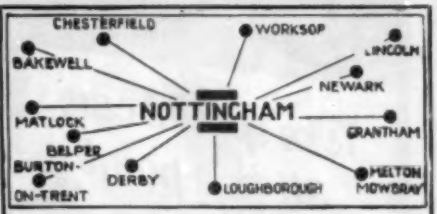
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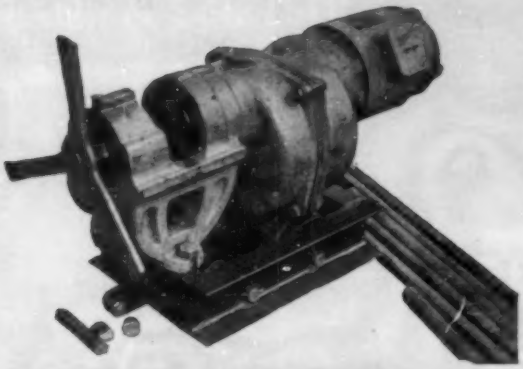
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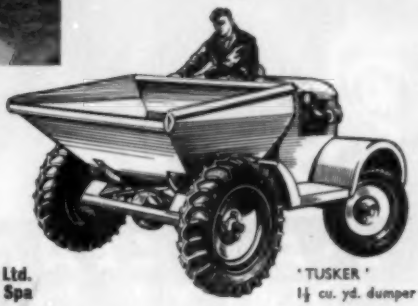
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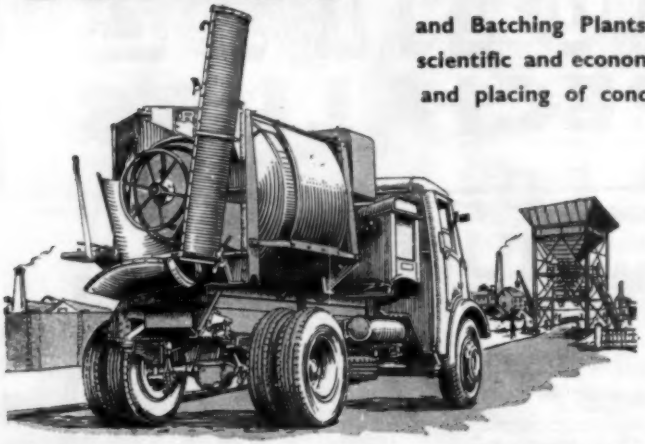
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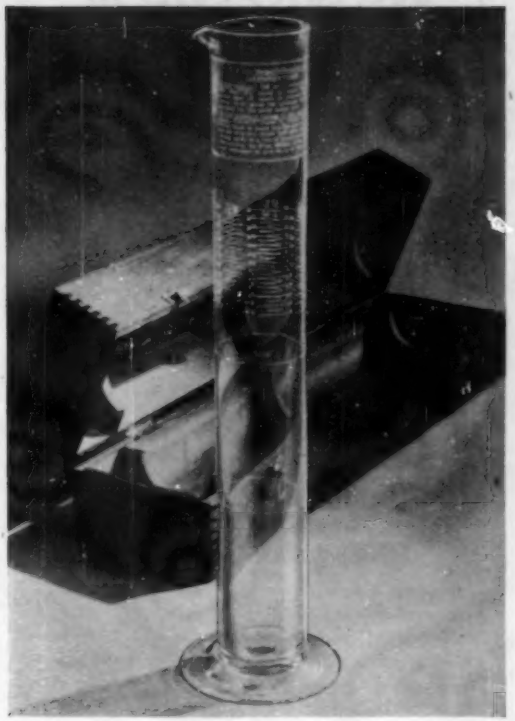


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CONCRETE AND CONSTRUCTIONAL ENGINEERING

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Volume LI, No. 5. LONDON, MAY, 1956.

EDITORIAL NOTES

Professional Status.

THE following statement has been sent to us for publication. It is headed " Engineers' ' Key to Future '. Give them Professional Status " :

" Britain's future prosperity depends upon her ability to continue to produce a sufficient number of professional engineers to keep pace with industrial developments of all kinds. Mr. J. G. Orr, National Secretary of the Engineers' Guild, addressing the Northern Ireland branch of the Guild in Belfast, said that at long last this fact had been recognised by the Government, which had recently published a White Paper on technical education. This was in a sense a blueprint for a great expansion of the profession. If sufficient young men are to be encouraged to undergo the rigorous training required to become a fully qualified engineer, then the profession must be made more attractive. For scores of years the professional engineer, the man who plans steel works, supervises the building of ships, creates new aircraft—in fact, the key man in every industry, has been ' Taken for granted '. In other countries the professional engineer in a position of responsibility is accorded professional status and is honoured for his contribution to the wealth of the nation. We are far behind other countries in that respect, although our own professional engineers have led the world in so many fields. If the Government and industry want more qualified engineers, then they must be prepared to treat them as professional men, just as they do doctors and lawyers, accountants and architects, and to remunerate them according to the key part they play in our national life. A recent survey of 725 of the biggest companies in the engineering industry showed that about 70 per cent. of the directors had no technical qualifications. In the case of about 300 of these companies there was no director on the board with technical qualifications. Professional engineers are naturally most concerned at this state of affairs. The increasing complexity of industrial processes demands that there should be an increasing proportion of management positions occupied by individuals with full technical qualifications. How can young people be expected to spend years in arduous study if, at the end, they see others without proper qualifications, not only better paid, but controlling their activities ? "

It is very doubtful whether the interests of engineers are advanced by this kind of propaganda and the use of such loose expressions. Who has denied that engineering is a profession or that engineers are professional people ? Is it necessary to suggest that in this country engineers are not now considered to be professional people, but should in future be so considered ? Why call the Government's White Paper a blueprint ?—it is a plan, not a copy. The Government employs thousands of professional engineers, architects, doctors, teachers, accountants, and others—does it not already treat them as professional people ? We are told that professional engineers are concerned because 70 per cent. of the directors

of 725 of the biggest companies in the engineering industry have no technical qualifications. This is misleading. The complexities of modern business are so vast that the qualifications of men in several other professions are essential to deal with finance, accounts, legal matters, labour relations, and so on, and commercial men are necessary to deal with sales. All these men have professional or technical qualifications. It might be thought that 30 per cent. of engineers on boards of directors is already a reasonable proportion, unless it is claimed that engineers should take over the duties of the men in other professions and the salesmen. Competence in one branch of technology is not the only requisite for controlling the affairs of a commercial concern. There is undoubtedly in engineering as great a percentage of men with the ability to take part in the control of an industry as there is in other professions, but we see no reason why it should be greater.

It is easy to make false (and foolish) assumptions. For example, unthinking members of Parliament have claimed that because a youth of eighteen is taken into the armed Services he should be allowed to vote in Parliamentary elections; they argue that if a youth is fit to fight he is fit to vote. Unreason could go no farther. It implies that when a youth dons Her Majesty's uniform he also clothes himself with a wisdom and political judgment that he did not have the day before, and that is not possessed by other youths of the same age who are not called to the Services and have no vote. It is equally unreasonable to claim that a man who has been awarded a degree in a scientific or technical subject or who has been elected to membership of a learned or professional society, or indeed who has achieved eminence in one branch of knowledge, is thereby fully qualified to control a public company.

It seems that some companies are very concerned with the difficulty they experience in finding technical men with the other qualifications necessary for controlling industry and for directing research. Recently, because of their anxiety about the supply of scientists and technologists whose qualifications include " a broad general outlook based on an arts background," Imperial Chemical Industries, Ltd., has provided scholarships at a cost of £35,000 a year to be awarded only to candidates who are acceptable as entrants to a university on the basis of their achievements in subjects other than science and who have not specialised in chemistry and physics at school. These men will then study science and technology, and it is hoped that they will form what the Company calls " a nucleus of really bright students ".

As is the case in most claims for improved " status ", it is not likely that much concern is felt about whether employers or neighbours consider that engineering is a profession. There is no doubt that it is a profession, and it is considered to be one. It is more likely that the object of the propaganda is the very laudable one of increasing the pay of salaried engineers and designers. If so, success is more likely to result from the formation of a strong trade union that can enforce their demands, rather than from a hope that higher incomes will automatically follow if the nation is reminded that engineering is a profession. After all, most doctors, head masters, and many other professional people, particularly in the employ of Government departments, local authorities, and nationalised industries, are already members of trade unions, and do not seem to be unduly concerned because they adopt the tactics of manual workers when they collectively make demands for more pay for professional services.

The Design of Non-Prismatic Beams.

By A. CHRONOWICZ.

BEAMS with varying moments of inertia are increasingly used in industrial structures, especially in connection with vaulted roofs and bridges of large span. Although the elastic constants of such beams are tabulated in technical literature, it is essential that the designer should be familiar with their evaluation by easily-remembered and economical methods.

The column-analogy method of Hardy Cross lends itself admirably to this task, and its application will be illustrated by the analysis of a slab bridge of three spans designed for standard rail loading (*Fig.* 1). Due to symmetry only half of the central span need be considered.

In the evaluation of constants, integrals are replaced by summations and the spans of the beam are divided into a convenient number of elements of constant length δs, which is subsequently omitted from the calculations together with the modulus of elasticity and the constant width, which in the example is 1 ft. Since the actual moment of inertia of each element is not required, only the function of its variable factor $\frac{I}{d^3}$ is tabulated, and expressed in terms of $d = 1{\cdot}95$ ft. which is assumed to be unity in order to avoid inconvenient figures.

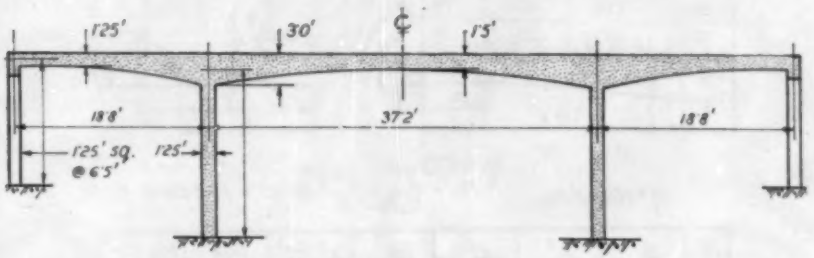


Fig. 1.—A Railway Bridge of Three Spans.

The soffit of the beam is set to a circular curve of large radius; therefore the ordinates d may be calculated using parabolic approximations. The static moment M_s is in 1000 lb.-ft. units for a load of 1000 lb. per foot. (*Fig.* 2).

In the final analysis the actual values of the elastic constants will be required to determine the stiffness of the spans; therefore at this stage the constants for the element assumed to be unity must be recorded. These are

$$I_s = I_0 = \frac{1{\cdot}95^3}{12} = 0{\cdot}62 \text{ ft.}^4; \text{ and } dA_0 = \frac{1{\cdot}86}{0{\cdot}62} = 3{\cdot}0.$$

The area and moment of inertia of the analogous column for the central span are given by $A' = 2 \times 11{\cdot}97 = 23{\cdot}9$, and $I'_{YY} = 2 \times 736 = 1472$. The analogous load is $G' = 2 \times 1{,}695{,}000 = 3{,}390{,}000$. The fixed-end moment is then

$$M_F = -\frac{3{,}390{,}000}{23{\cdot}9} = -142{,}000 \text{ ft.-lb.}$$

The stiffness is equal to the stress in the analogous column under unit load acting at the end of the span: $S' = -\frac{18{\cdot}6^2}{1472} - \frac{1}{23{\cdot}9} = -0{\cdot}277$. The corresponding stress at the far end of the span is $\frac{18{\cdot}6^2}{1472} - \frac{1}{23{\cdot}9} = 0{\cdot}193$.

The ratio of this moment to the stiffness gives the carry-over-factor

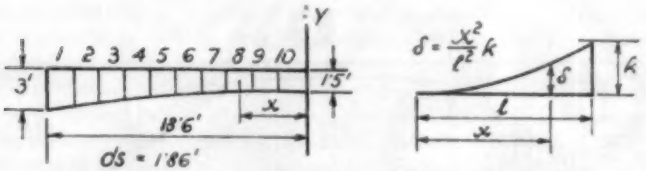
$$r = -\frac{0{\cdot}193}{0{\cdot}277} = -0{\cdot}7,$$

which is positive in the sign convention usually employed in moment-distribution methods.

The actual moment of inertia of the element is given by $I_x = \frac{I_x}{I_0} I_0$, and the actual elastic constants for the span may be easily evaluated as follows.

$$A = \frac{\delta s}{I_0}\Sigma\frac{I_0}{I_x} = \frac{\delta s}{I_0}A'. \quad I_{YY} = \frac{\delta s}{I_0}\Sigma\frac{I_0}{I_x}x^2 = \frac{\delta s}{I_0}I'_{YY}.$$

$$S = -\frac{1}{\frac{\delta s}{I_0}A'} - \frac{\frac{1}{4}l^2}{\frac{\delta s}{I_0}I'_{YY}} = -\frac{I_0}{\delta s}\left(\frac{1}{A'} + \frac{\frac{1}{4}l^2}{I'_{YY}}\right) = \frac{I_0}{\delta s}S'.$$

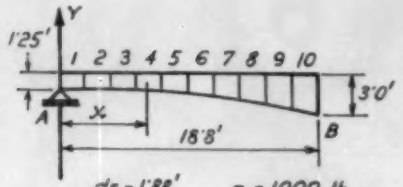


$q = 1000$ lb. $\quad M_0 = \frac{l^2}{8}q = \frac{37{\cdot}2^2}{8}1000 = 173\,000$ lb-ft.

N	x	x^2	d	$1/d^3$	x^2/d^3	Ms	Ms/d^3
10	·9	1	1·50	2·20	2·2	172·5	380
9	2·8	8	1·53	2·06	16·5	169·0	348
8	4·7	22	1·60	1·81	39·8	162·0	293
7	6·5	42	1·68	1·57	65·9	151·0	237
6	8·4	71	1·81	1·25	88·6	137·5	172
5	10·2	104	1·95	1·00	104·0	119·0	119
4	12·1	146	2·13	·77	112·6	100·1	77
3	14·0	196	2·35	·57	111·8	75·0	43
2	15·8	250	2·58	·43	107·6	48·0	21
1	17·7	313	2·86	·31	97·1	16·5	5
Σ				11·97	736		1695

Ms and Ms/d^3 columns given in 1000 lb-ft units.

Fig. 2.



$ds = 1{\cdot}88'$ $\quad q = 1000$ lb.

$$M_0 = \frac{18{\cdot}8^2}{8} 1000 = 44\,250 \text{ lb-ft.}$$

N	x	x^2	d	$1/d^3$	$x^2 1/d^3$	Ms	$Ms\,1/d^3$
1	·9	1	1·25	2·89	2	8·0	21
2	2·8	8	1·29	2·62	21	22·4	164
3	4·7	22	1·36	2·24	50	33·1	348
4	6·6	43	1·47	1·77	77	40·3	472
5	8·5	72	1·61	1·35	97	43·8	504
6	10·3	106	1·78	1·00	106	43·8	451
7	12·2	149	1·98	·73	109	40·3	359
8	14·1	199	2·23	·51	101	33·1	238
9	16·0	256	2·52	·35	90	22·4	126
10	17·9	320	2·98	·21	67	8·0	30
					720		2713

Ms and $Ms.1/d^3$ given in 1000 lb-ft units.

Fig. 3.

In this example the actual stiffness (S) of the central span is

$$\frac{0{\cdot}62}{1{\cdot}86} \times 0{\cdot}277 = 0{\cdot}092.$$

The moment due to the end displacement in the analogous column is equivalent to the stress caused by the moment acting about axis YY and equal to the displacement:

$$M_\Delta = \frac{\Delta \frac{l}{2}}{\frac{\delta s}{EI_0} I'_{YY}} = \frac{EI_0}{\delta s} \times \frac{\Delta}{I'} \times \frac{l}{2}.$$

In the example this is equal to $M_\Delta = E\Delta \dfrac{0{\cdot}62 \times 18{\cdot}6}{1{\cdot}86 \times 1472 \times 2} = 0{\cdot}0042 E\Delta.$

Assuming that the settlement (Δ) of the end support is ½ in. and that

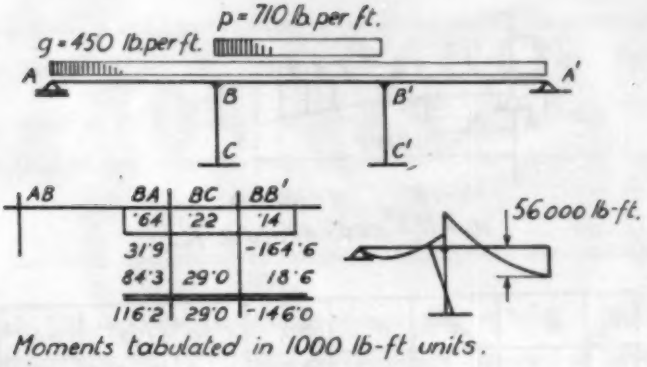


Fig. 4.

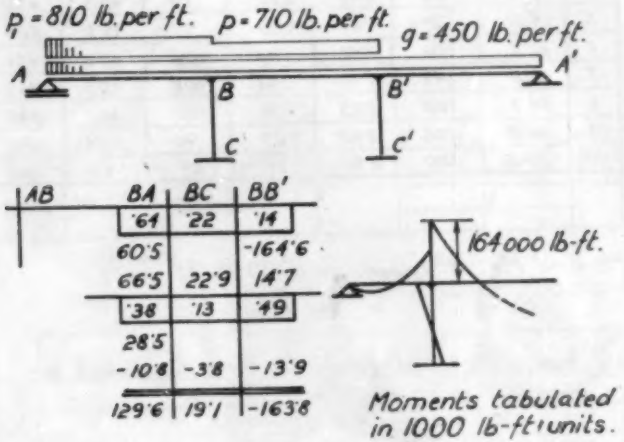


Fig. 5.

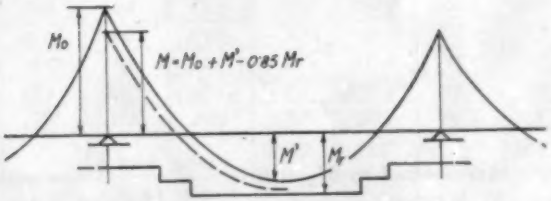


Fig. 6.—Bending Moment Diagram.

$E = 4 \times 10^6$ lb. per square inch $= 575 \times 10^6$ lb. per square foot, this moment is equal to $M_{\Delta=1 \text{ in.}} = \dfrac{0{\cdot}0042 \times 575 \times 10^6 \times 0{\cdot}5}{12} = 101{,}000$ ft.-lb.

The end span, which is assumed to be freely supported at A, is divided into ten elements, and the depth of the sixth element is assumed to be unity, consequently

$$\delta_s = 1{\cdot}88 \text{ ft.}, \qquad I_0 = \frac{1{\cdot}78^3}{12} = 0{\cdot}47 \text{ ft.}^4.$$

The computation of elastic constants is tabulated in *Fig.* 3.

$$I_{YY} = 720. \quad S_{BA} = \frac{18{\cdot}8^2}{720} \times \frac{0{\cdot}47}{1{\cdot}88} = 0{\cdot}123.$$

$$M_F = -\frac{2{,}713{,}000}{720} 18{\cdot}8 = -70{,}800 \text{ ft.-lb.}$$

$$M_\Delta = \frac{E\Delta \times 18{\cdot}8}{720} \times \frac{0{\cdot}47}{1{\cdot}88} = 0{\cdot}0065E\Delta.$$

$$M_{\Delta=1 \text{ in.}} = \frac{0{\cdot}0065 \times 575 \times 10^6 \times 0{\cdot}5}{12} = 156{,}000 \text{ ft.-lb.}$$

The stiffness of the supporting walls is given by

$$S = \frac{4d^3}{12 \times l} = \frac{1{\cdot}25^3}{3 \times 16} = 0{\cdot}041.$$

In the calculation of the final moments, the full use of the symmetry of the structure will be made by replacing the unsymmetrical load by symmetrical and antimetrical systems. The stiffness of the central span will therefore be corrected as required by the introduction of the constant of the end rotation for the span AB, which is generally given by

$$k_{AB} = \frac{1 - r_{AB}r_{BA}}{1 - r_{BA}\dfrac{M_{BA}}{M_{AB}}},$$

where r_{AB} and r_{BA} are carry-over factors and M_{AB} and M_{BA} are final end moments on the beam. In this example, for the central span and for a symmetrical system, this is

$$k_1 = \frac{1 - 0{\cdot}7 \times 0{\cdot}7}{1 - 0{\cdot}7 \times (-1)} = \frac{0{\cdot}51}{1{\cdot}7} = 0{\cdot}3,$$

and for an antimetrical system $k_2 = \dfrac{0{\cdot}51}{1 - 0{\cdot}7} = 1{\cdot}7.$

Moment-distribution factors for symmetrical loading at the support are calculated as follows.

$$\alpha_{BA} = \frac{0{\cdot}123}{0{\cdot}123 + 0{\cdot}041 + 0{\cdot}3 \times 0{\cdot}092} = \frac{0{\cdot}123}{0{\cdot}191} = 0{\cdot}64.$$

Fig. 4 gives the load diagram and moment-distribution table for the maximum moment on the central span, while in *Fig.* 5 the maximum support moment is found. The actual fixed-end moments are calculated by proportion from moments previously evaluated for unit loading.

In designing the reinforcement for positive moments, an adequate allowance should be made for possible settlement of the supports. It is reasonable, however, to reduce the theoretical support-moment by the difference between the corresponding moment in the adjacent span and its moment of resistance, multiplied by an arbitrary factor of safety, which may be 0·85 (*Fig.* 6).

Design for a Station Roof.

The "Concrete and Constructional Engineering" Prize.

EACH year a prize of £25 is given by the proprietors of this journal to the Department of Concrete Technology of the Imperial College of Science and Technology (University of London) for competition amongst the post-graduate students. The competition is arranged by Professor A. L. L. Baker.

For the year 1955 the competition was for a design for the reconstruction of part of London. It was assumed that a large area between Victoria station and the river Thames was to be cleared and replanned, and that vessels of 20,000 tons would be able to be moored within 200 ft. of the river bank. The new structures were to include office buildings and residential flats up to twenty stories high, a new railway station, a landing stage for helicopters over part of the railway sidings, new road and railway bridges, a jetty for vessels of 20,000 tons, and a warehouse with a capacity of 60,000 tons of merchandise. A general arrangement plan for the area was required, but most importance was attached to the design of the structures in reinforced concrete.

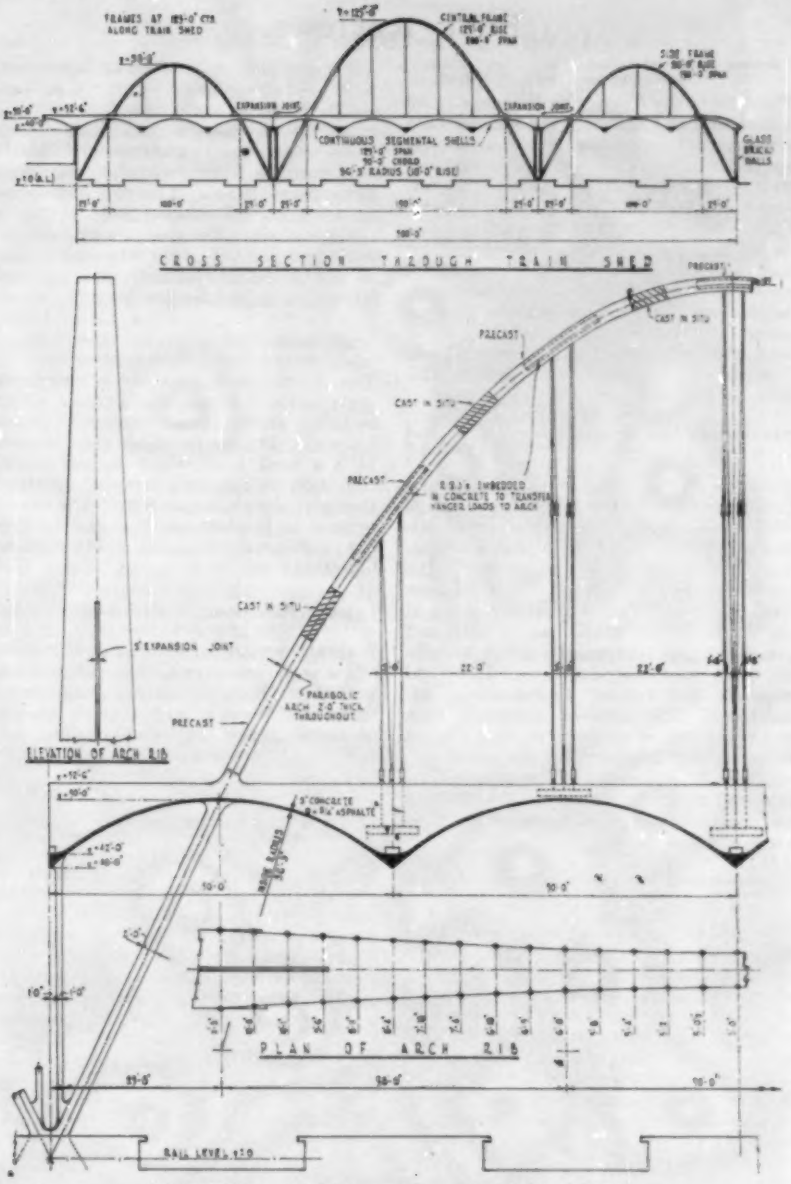
The thirty-one designs submitted were judged by Mr. Leslie Turner, B.Sc., M.I.C.E., Past-President of the Institution of Structural Engineers, who awarded the prize to Mr. F. H. Turner, B.Sc., A.M.I.C.E., for what the assessor describes as an outstanding and original design for a reinforced concrete roof over the new Victoria station.

The winning design is illustrated on page 365. The requirements were assumed to be (*a*) an arrangement of tracks requiring the use of fewer platforms, (*b*) the station to be completely roofed, and (*c*) the supports for the roof to be as few as possible in order to permit future rearrangement of the platforms.

In this design thin vaults are used as they were considered to be the most economical method of covering a large area. The vaults would be supported by bow-string arches which, being subjected mainly to compressive stresses, are able to span large distances with few supports. The arches have a parabolic shape and are of constant thickness. The width at any point is equal to sec φ times the width at the crown.

The vaults would be 50 ft. wide by 125 ft. long and supported from the arches by rods at 50-ft. centres. Three arcaes, at 125-ft. centres, cover the width of the station, the central arch spanning 200 ft. and the side arches 150 ft. each. The arches were analysed by the method of moment distribution.

Mr. F. H. Turner has been awarded a Diploma of Imperial College.



Design for a Station Roof. (*See page* 364.)

Book Reviews.

"Betong - Proporsjonering." By Sven Thaulow. (Oslo: Norsk Cementforening. 1955. No price stated.)

PRINTED in the Norwegian language (with a summary in English), the book describes a method of proportioning concrete mixtures based upon the fineness modulus of the aggregates, the unit water content, and the ratio of sand to coarse aggregate. Charts are given to facilitate the calculations, but would require replotting for use in this country as they are based upon the use of Norwegian cements. Adjustments of the proportions may be made on the site, using the methods of testing described by the author in "Field Testing of Concrete", reviewed in this journal for May 1954.

"Luftporenbildende Betonzusatzmittel." By Kurt Walz and Else Hartmann. (Berlin: Wilhelm Ernst & Son. Price 9 D.M.)

THIS publication of the German Select Committee for Reinforced Concrete deals with air-entraining agents under the following headings: (1) Chemical composition and action; (2) Influence on the formation of air voids; (3) Influence on freshly-mixed concrete; (4) Influence of air voids on the properties of hardened concrete; (5) Determination of volume of voids in freshly-made and hardened concrete and testing air-entraining admixtures. The authors conclude that the resistance of concrete to frost can be economically increased by the use of air-entraining agents, but the volume of air required must be determined in each case and continuously supervised in order to keep it within permissible limits.

"Vorberechnung der Verbundträger." By H. J. Schrader. (Berlin: Wilhelm Ernst & Sohn. Price 27 D.M.)

THE author presents a method of calculating steel I-beams or plate-girders carrying a reinforced concrete slab. The approximate formulæ given allow for a rapid determination of sizes of beams and of prestressing forces required in the slab to avoid or limit tensile stresses in a concrete deck subjected to moving loads. With given sections and loads the stresses in statically-determinate and statically-indeterminate beams, with or without prestress, and including the influence of creep and shrinkage of the concrete, can be readily established by means of design charts.

For statically-indeterminate beams with webs between about 3 ft. 3 in. and 20 ft. formulæ are given for the rapid integration of the "virtual work" equations, elastic deformations and plastic deformations after creep and shrinkage have taken place. This work is based upon a theory developed by K. Sattler in "Theorie der Verbund Konstruction" published in 1953, but the derivations of the principal formulæ are omitted. Numerical examples are given.

"Italy Builds." By G. E. Kidder Smith. (London: Architectural Press, Ltd. Price 56s.)

THE most valuable feature of this handsome volume is the illustrations, which include nearly 600 beautiful photographs of Italian buildings old and new. It is a book from which architects and engineers seeking new forms of construction may derive inspiration. The text is printed in English and Italian, but does not sufficiently describe the structures illustrated.

"Carpentry and Joinery." By F. Keeling. (London: Cleaver-Hume Press, Ltd. Price 21s.)

WRITTEN for the use of advanced students of carpentry, this book deals exhaustively with the setting-out of handrailing, church furniture, wooden roof trusses (mostly mediæval types), lantern-lights and roof turrets. There is also a chapter on shuttering for concrete.

"Building Technique for Domestic and Similar Structures." By Edwin Gunn. 3rd edition. (London: Iliffe & Sons, Ltd. Price 21s.)

IN this book no attempt is made to provide a comprehensive work on building construction, but rather to give a few general notes and sketches that should be useful to students and apprentices. The chapter on "Concretor" occupies six pages, and gives no detailed information on the erection of concrete structures.

"The Properties of Aluminium and its Alloys." (London: Aluminium Development Association. Revised 1955. Price 7s. 6d.)

THIS book presents in a concise form the composition and properties of various products of aluminium and its alloys, with tables. An appendix gives the composition of various British and foreign alloys and their proprietary names.

Cooling Tower at Drakelow Power Station.

A COOLING tower (*Fig.* 1) recently built for the Central Electricity Authority at Drakelow is 310 ft. high by 157 ft. diameter at the top and is supported by 64 inclined columns 30 ft. high and 2 ft. diameter. The columns form a circle 240 ft. in diameter. At the head of the columns the wall of the tower is 2 ft. thick and tapers to 5 in. at a height of 100 ft. above the pond; this thickness is maintained to the top.

The circulating water flows through an external annular reinforced concrete channel (*Fig.* 3) constructed after the wall of the tower was completed. From the channel the water is conveyed in asbestos-cement pipes to an irrigation stack inside the tower.

Internal scaffolding (*Fig.* 2) was used for the construction of the tower with an external working platform suspended as shown in *Fig.* 4. Access to the working level was by means of a hoist inside the tower. Shutters of cast aluminium were used; these were 2 ft. wide and provided for a lift of concrete of 3 ft. 6 in.

The concrete, which was not vibrated, was specified to have a minimum compressive strength of 3675 lb. per square



Fig. 1.—Completed Tower.

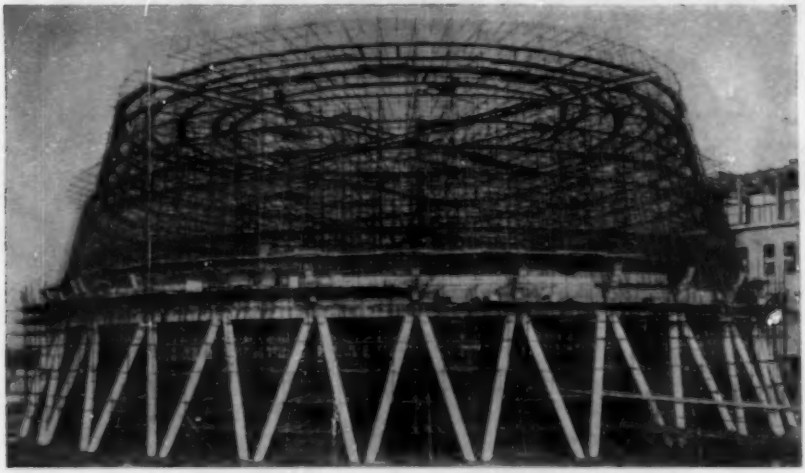


Fig. 2.—Reinforcement for Lower Part of Wall.

inch at 28 days. The materials were proportioned by weight to provide volumetric proportions of about 1 : 1½ : 3. Ordinary Portland cement was used. The concrete was conveyed in jubilee skips from the mixing plant to the hoist, which lifted it to a hopper from which it was wheeled in barrows to where it was to be placed.

Inside the tower are precast columns and beams (*Figs.* 5 and 6) to carry the baffles. The radial beams have inclined slots in which are fitted timber slats. Extending from the ends of the ring-beams and bearers are U-shaped reinforcement bars which are hooked around dowel bars extending from the lower precast columns (*Fig.* 7). The upper columns have vertical holes in their lower ends which fit over the dowel bars. When all the members forming a joint were in position the joint was filled with grout. The top bearers are wider than the lower ones and the slots do not extend through the width of the beam. Additional slots are provided in these beams so that two sets of baffle-boards can be accommodated one above the other and sloping in opposite directions. The precast units

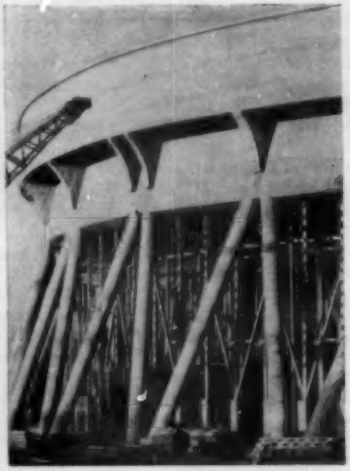


Fig. 3.—Annular Water Channel Completed.

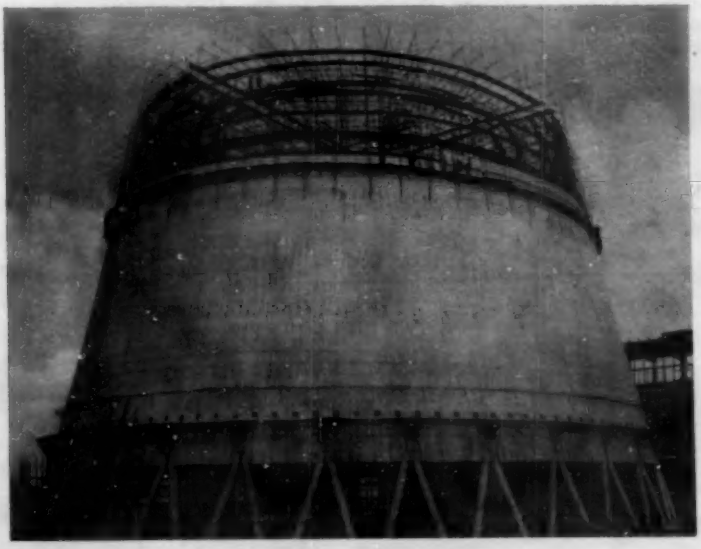


Fig. 4.—Shuttering and Working Platform.

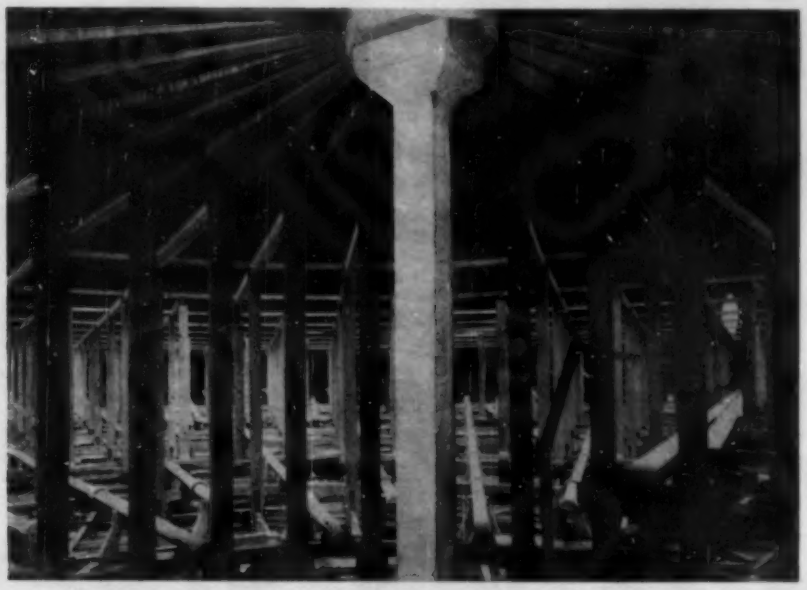


Fig. 5.—Arrangement of Columns and Beams at Middle of Tower.

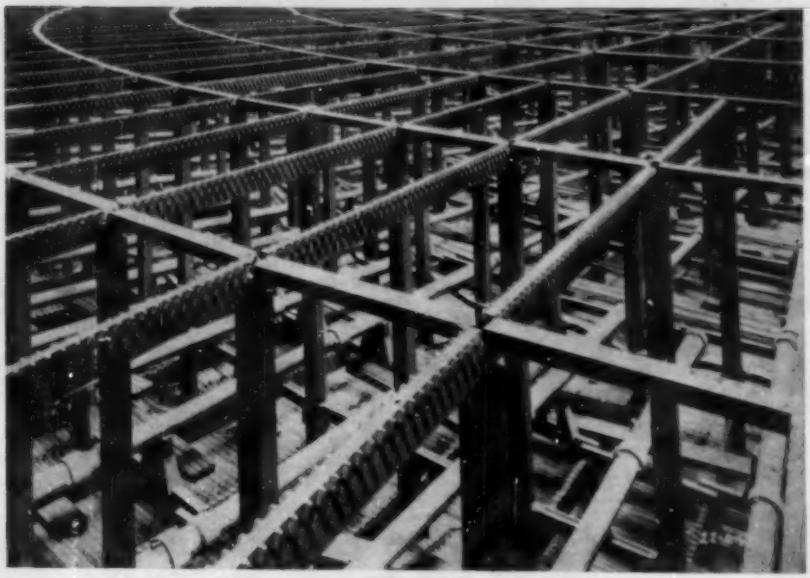


Fig. 6.—Precast Supports for Baffles.

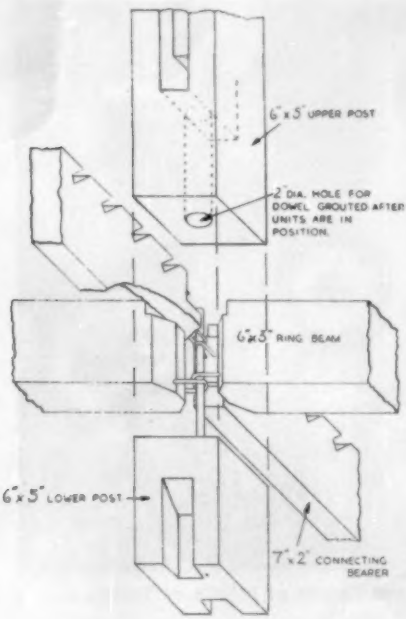


Fig. 7.—Detail of Joint.

were specified to have a minimum compressive strength of 5000 lb. per square inch at seven days.

The consulting engineers are Messrs. L. G. Mouchel & Partners, Ltd., and the contractors were the Mitchell Construction Co., Ltd. The precast units were made by Shockcrete, Ltd.

The Ultimate Load Method of Design.

In Professor Baker's article on "The Ultimate Load Method of Design" in this journal for March 1956, the reference numbers (1) and (2) on Fig. 2, page 301, should be transposed. We regret this mistake.

Lifting Circular Slabs.

Circular school buildings are being constructed in Connecticut, U.S.A., by the lifted-slab method. The buildings have a diameter of 90 ft., and the reinforced concrete floor and roof are 100 ft. diameter to allow for a path 5 ft. wide under a 5-ft. projection of the roof. There are two concentric rings of columns. The inner ring is 33 ft. 2 in. diameter and consists of six equally-spaced steel tubes 5½ in. diameter. Twelve steel columns 6½ in. square form an outer ring of 90 ft. diameter, and these also form alternate vertical mullions for the circumferential glass walls.

The two reinforced concrete slabs are cast one on top of the other on the ground. They are reinforced radially and circumferentially, and there is additional reinforcement in bands 10 ft. wide over the outer columns and 7 ft. 6 in. wide over the inner columns. The foundations and columns were designed to have a high moment of resistance on account of the method of lifting the slab. When the floor slab had been cast it was painted with two coats of a compound to prevent the top slab adhering to it. Steel lifting collars were placed over the columns and positioned ¾ in. above to allow for grouting around the collars later. The top slab, which was 10 in. thick and contained 241 cu. yd. of concrete, was then cast.

The slabs were cured by ponding and were not lifted until they attained a strength of 2400 lb. per square inch. The slabs were lifted at a rate of 4 ft. to 5 ft. per hour by means of eighteen hydraulic jacks operated from two panels each of which controlled nine jacks. When the slab had reached the required height it was supported by two steel plates ¾ in. thick welded to opposite sides of each column.

The architect is Mr. Warren Ashley, the engineers are Messrs. Marchant & Minges, and the contractors are the New England Lift Slab Corporation. The foregoing is abstracted from "Engineering News-Record" for November 1955.

Stand at a Football Ground.

AN upper tier (*Fig.* 1) providing nearly 6500 seats has been added to the stand at the Lansdowne Road football ground, Dublin. The lower tier, with 2300 seats, has been retained, but it is planned to replace this later with a new terrace providing 6500 seats. The site was restricted by the railway line, which is on an embankment 10 ft. above the pitch. By permission of the Irish Railways the stand has been built over the railway, with exits over and under the tracks. Work was commenced in the early summer of 1954, and as much as possible was precast in order to complete the work within ten months.

The upper part of the stand spans the railway for over 100 yd. at an average height of 50 ft., and access is through tunnels under the lines. The tunnels could be constructed only at week ends. The design is based on the fact that the Irish Railways were able to precast the tunnel units, which are 10 ft. wide by 7 ft. high internally by 5 ft. 4 in. long and weigh 11 tons. Six units were required to form a tunnel, and four tunnels of double width were constructed. The units (*Fig.* 3)



Fig. 1.—Work in Progress on the Upper Tier.

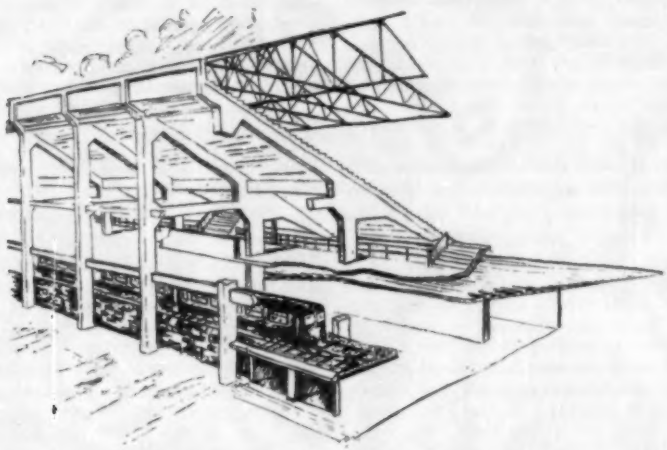


Fig. 2.—Stand Built over a Railway.



Fig. 3.—Prestressing a Tunnel.



Fig. 4.—Method of Supporting Precast Beams, and Shuttering for Inclined Beams.

were made of concrete mixed in the proportions of 1 : 1½ : 3 by weight with a minimum strength of 3600 lb. per square inch at 28 days. They were aligned by means of dowel-bars of 1¼ in. diameter which fitted into holes in the adjacent units. The six units were prestressed together by means of ten ⅝-in. Lee-McCall bars. Underpinning was necessary to prevent damage to the retaining walls of the embankment.

The stand (*Fig.* 2) comprises thirteen main frames generally at 29-ft. 4-in. centres, with longitudinal beams carrying intermediate rakers with a slope of 1 in 1·76 and about 82 ft. long including a cantilever of 29 ft. at the front. The concrete was required to have a strength of 3000 lb. per square inch at 28 days.

The front and rear columns were cast in place to the required height, precast beams about 32 ft. long placed on brackets on the columns, and the joints concreted. A working platform the full length of the stand was erected on these frames and the upper part of the stand was then constructed (*Fig.* 4). The material was delivered by a tower crane on a track at the rear of the stand. The concrete steps, to which wooden seats are fixed, were precast on the site ; they are 14 ft. 8 in. long, and have a rise of 1 ft. 5 in. and treads of 2 ft. 6 in. The roof is of steel covered with asbestos-cement sheets.

The architects are Messrs. Jackson & Edmonds and the consulting engineer Mr. Septimus Willis, M.I.C.E. The general contractors were Messrs. E. Stone & Sons, Ltd.

A Hungarian Award.

A KOSSUTH Prize of £1000 has been awarded to Mr. Gyula Mátrai, an engineer in the Hungarian Ministry of Building, for his work in developing the use of large precast concrete members in the construction of power stations and other industrial structures. In the Pécsujhegy power station now being built, the walls will be built entirely of precast panels with an area of 1400 sq. ft. which act as load-bearing members. The roof comprises precast slabs spanning 66 ft. It is estimated that this method results in a saving of about 25 per cent. of the materials that would have been required for in-situ construction. All the precast elements, including columns, wall panels, and some of the floors, are hollow and form part of the ventilation system of the power station.

Design of Column Foundations and Rigid Rafts.

A Graphical Method.

By J. W. WHITE, B.Sc., A.M.I.C.E., A.M.I.Struct.E.

THE sizes of foundations for rectangular columns and of rigid rafts may be obtained by graphical means instead of by the trial-and-error methods in which the length and width of a base are assumed and, if the resulting load exceeds the bearing capacity of the soil, the process is repeated until a shape and size are obtained that result in a pressure within the bearing capacity of the soil. A certain amount of trial and error is still necessary even when using graphs, due to the fact that there is an infinite number of solutions of each case. However, by fixing one of the two variables, that is the stability or the proportion of the length to the width, the size of the base is obtained directly from the graphs. The method is applicable to rigid foundations which impose a load of uniformly-varying intensity (trapezoidal or triangular distribution) on the soil.

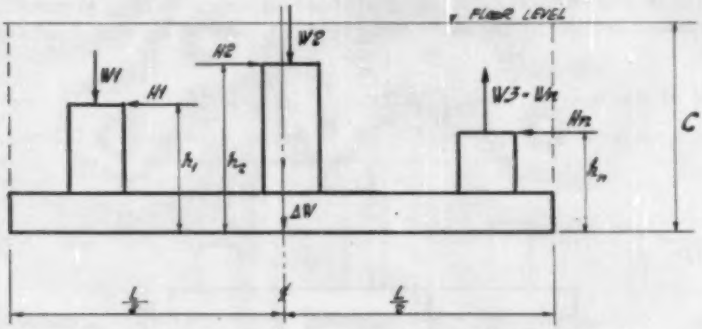


Fig. 1.—General Case of Raft supporting *n* Columns.

The following assumptions are made. (a) Local deflections under heavy loads are negligible. This is almost true for rigid foundations and for uniform subsoil. (b) Passive and frictional resistance of the soil on vertical faces and the shearing resistance of the soil are neglected. The only resistance to the loading is therefore normal to the underside of the foundation. This condition exists if the foundation is shallow compared with its area or if the backfill has not been properly consolidated. (c) The stability of the foundation is based on the resistance against overturning about one edge.

NOTATION.—A = area of foundation. B = width of foundation. L = length of foundation. Z = section modulus of base in horizontal plane. b_1 = ratio of width to length of foundation. C = depth of base of foundation below ground. H = horizontal force at stanchion base. M = sum of overturning moments acting on the foundation. W = sum of column loads. ΔW = weight of foundation and soil over the area of the foundation. R = sum of the vertical forces.

e = eccentricity. e_1 = specific eccentricity = $\frac{e}{L}$. p = maximum pressure on the soil. s = stability against overturning, or stability factor.

Fig. 1 shows the general case of a raft supporting n columns. Each base-plate transmits to the foundation vertical and horizontal forces and a moment. Usually the columns are all on the centre-line of the raft and the moments act in a vertical plane through the centre-line; only such cases are considered here. To evaluate the reaction of the soil the equivalent loading shown in *Fig.* 2 is found as follows:

$$R = \Sigma W_n + \Delta W \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$M = \Sigma M_n + \Sigma H_n h_n \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$e = \frac{M}{R} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Upon the value of the specific eccentricity depends the shape of the soil-pressure diagram. For example, if e_1 is greater than zero but less than one-sixth the distribution is trapezoidal (Case 1, *Fig.* 3), and if e_1 is greater than one-sixth the distribution is triangular (Case 2, *Fig.* 4).

The stability against overturning (s) about the edge a—a (*Fig.* 5) is the resisting moment divided by the overturning moment. Assuming that R acts at the centre of the base, $s = \frac{R\frac{L}{2}}{M} = \frac{L}{2e} = \frac{1}{2e_1}$, or $e_1 = \frac{1}{2s}$ . . . . (4)

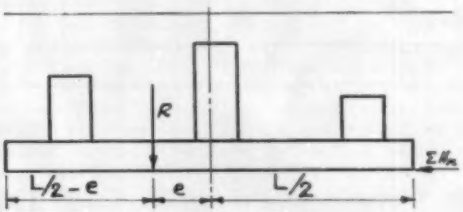


Fig. 2.

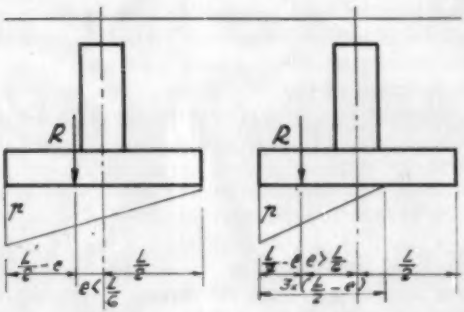


Fig. 3.

Fig. 4.

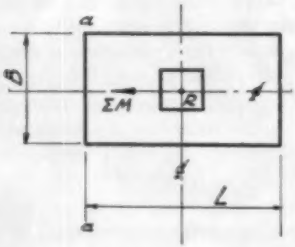


Fig. 5.

It is usual for s to be greater than 2, that is e_1 less than 0·25, although sometimes, if the load causing the eccentricity is of short duration and rare occurrence, a minimum value of 1·5 is used, corresponding to a maximum specific eccentricity of 0·33.

Derivation of Formulæ.

CASE I.—e_1 less than one-sixth (*Fig.* 3). The maximum pressure on the earth is given by

$$p = \frac{R}{A} + \frac{Re}{Z} = \frac{R}{LB} + \frac{Re6}{L^2B}.$$

Writing $K = \frac{pe^2}{R}$ and $b_1 = \frac{B}{L}$,

$$K = \frac{e_1^2 + 6e_1^3}{b_1} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

CASE II.—e_1 greater than one-sixth (*Fig.* 4). The resistance of the earth is given by $\frac{1}{2}p3\left(\frac{L}{2} - e\right)B = R$. Therefore, $p = \frac{4R}{3(L - 2e)B}$, and, again writing $K = \frac{pe^2}{R}$ and $b_1 = \frac{B}{L}$,

$$K = \frac{4e_1^2}{3b_1(1 - 2e_1)} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

As a check, if e_1 is one-sixth, equations (5) and (6) must give the same answer. That is:

Case I. $K = \frac{\frac{1}{6^2} + 6\frac{1}{6^3}}{b_1} = \frac{1}{18b_1}$. Case II. $K = \frac{4 \times \frac{1}{6^2}}{3b_1\left(1 - 2 \times \frac{1}{6}\right)} = \frac{1}{18b_1}$.

It is sometimes assumed that the maximum pressure on the soil is caused by the maximum load on the foundation. However, it is seen from *Fig.* 6 that a smaller load at a greater eccentricity can produce a greater pressure, and it is recommended that the minimum load with maximum eccentricity should always be investigated in addition to the case of maximum load.

Equations (5) and (6) are plotted in Graphs I to VI and these are sufficient to determine the sizes of rectangular bases for any combination of load, allowable pressures, and depth of foundation. Graphs I, II, and III are used for bases with L greater than B and Graphs IV, V and VI for bases with B greater than L. Smaller values of e_1 than 0·02 are rare. In the region where e_1 is between zero and 0·02 the curves are very flat, and for this reason the values for $\frac{100e^2p}{R}$ are shown in *Table* I.

Examples.

Examples can be divided into two groups, namely (i) with small eccentricity (the base will generally be square), and (ii) with large eccentricity (this will

result in a rectangular base .and a choice of the ratio $\frac{B}{L}$ will have to be made).

EXAMPLE I.—$M = 80$ ft.-tons, $W = 100$ tons, $H = 5$ tons 1 ft. below the floor, and $C = 5$ ft. The weight of soil and foundation combined is assumed

TABLE I.

$e_1 = \frac{e}{L}$	0·005	0·010	0·015	0·020
$B = 4L$	0·000644	0·002650	0·006132	0·011200
$B = 3L$	0·000858	0·003533	0·008175	0·014933
$B = 2L$	0·001288	0·005300	0·012263	0·022400
$B = 1{\cdot}5L$	0·001716	0·007067	0·016350	0·029867
$L = B$	0·002575	0·010600	0·024525	0·044800
$L = 2B$	0·005150	0·021200	0·049050	0·089600
$L = 3B$	0·007725	0·031800	0·073575	0·134400
$L = 4B$	0·010300	0·042400	0·098100	0·179200

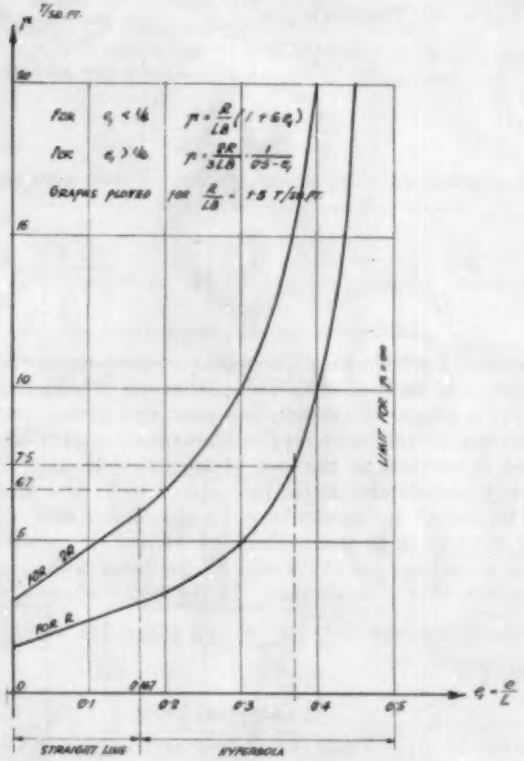
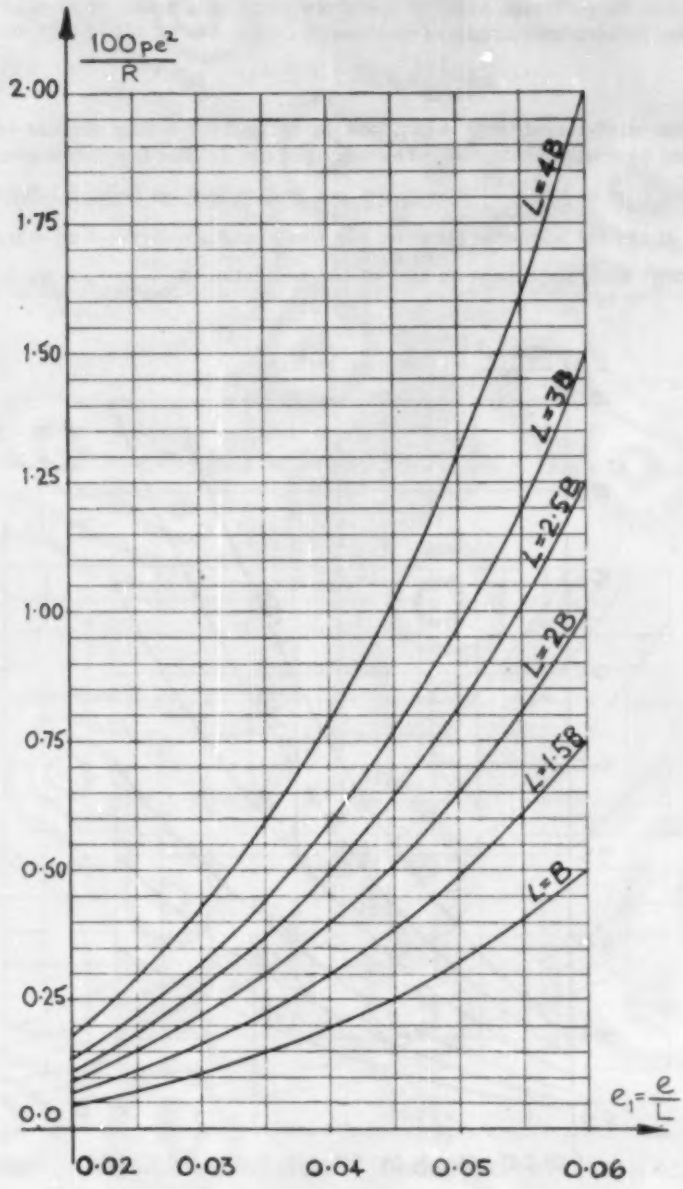


Fig. 6.

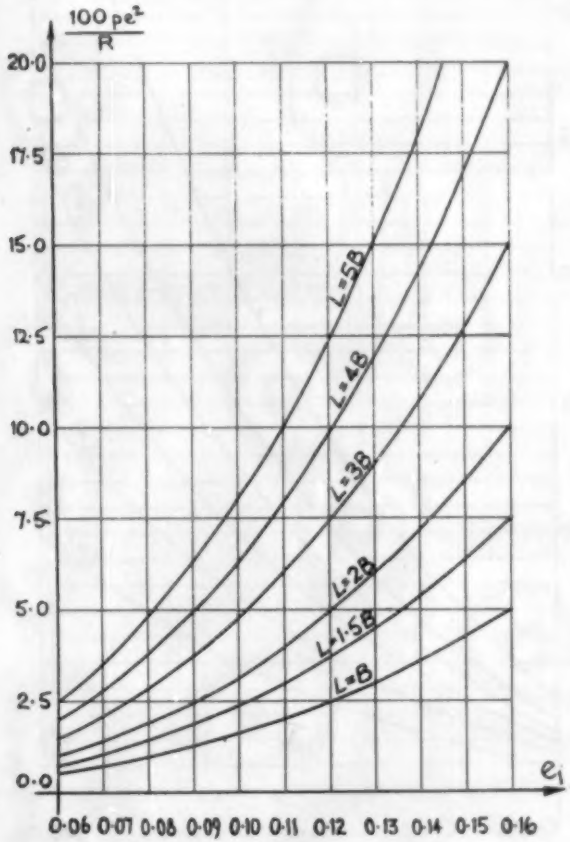

100pe²/R
2·00
1·75
1·50
1·25
1·00
0·75
0·50
0·25
0·0
0·02
0·03
0·04
0·05
0·06
e₁=e/L
L=4B
L=3B
L=2·5B
L=2B
L=1·5B
L=B

Graph I.

to be 112 lb. per cubic foot. $p = 0{\cdot}5$ ton per square foot. It is required to find the breadth and length of the base.

$$e = \frac{\Sigma M}{W} = \frac{80 + 5 \times 4}{100} = 1 \text{ ft.}$$

For this small eccentricity (which will be reduced by taking account of ΔW) a square base will be adopted. The weight of the soil and foundation at a depth of 5 ft., that is $5 \times \frac{112}{2240} = 0{\cdot}25$ ton per square foot, is deducted from p to arrive at the net allowable pressure. In this case $p_{net} = 0{\cdot}5 - 0{\cdot}25 = 0{\cdot}25$ ton per square foot, the minimum area of the foundation is $\frac{100}{0{\cdot}25} = 400$ sq. ft., and



Graph II.

the minimum weight of soil and foundation (ΔW) is $400 \times 0{\cdot}25 = 100$ tons. Then the sum of the vertical forces $R = 100 + 100 = 200$ tons. Therefore the maximum eccentricity is $\frac{100}{200} = 0{\cdot}5$ ft. Now calculate

$$\frac{100e^2p}{R} = \frac{100 \times 0{\cdot}25 \times 0{\cdot}5}{200} = 0{\cdot}0625.$$

Then, from Graph I, obtain $e_1 = 0{\cdot}023$ and $L = \frac{0{\cdot}5}{0{\cdot}023} = 21{\cdot}7$ ft. Use

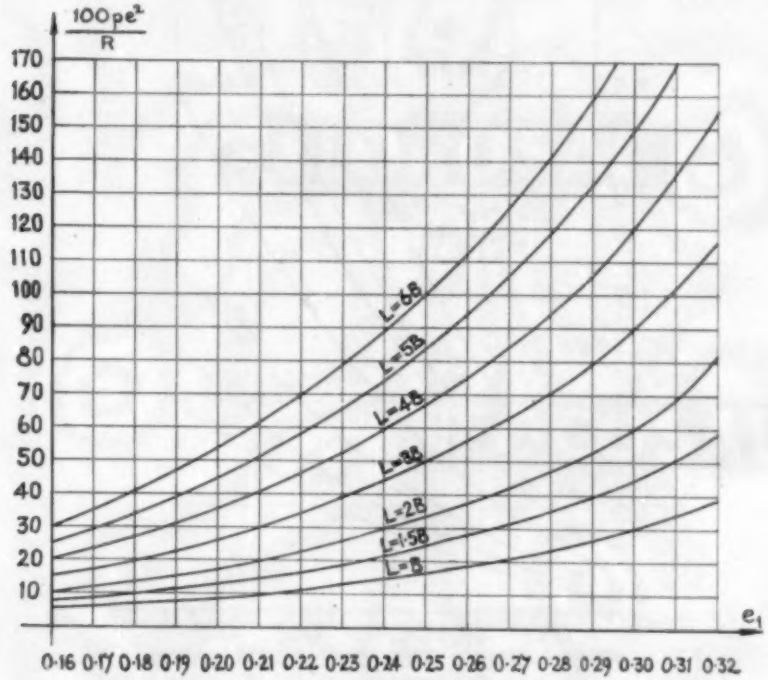
$$L = B = 21 \text{ ft. } 9 \text{ in.}$$

To check the maximum pressure, $\Delta W = 21{\cdot}75^2 \times 0{\cdot}25 = 118$ tons and

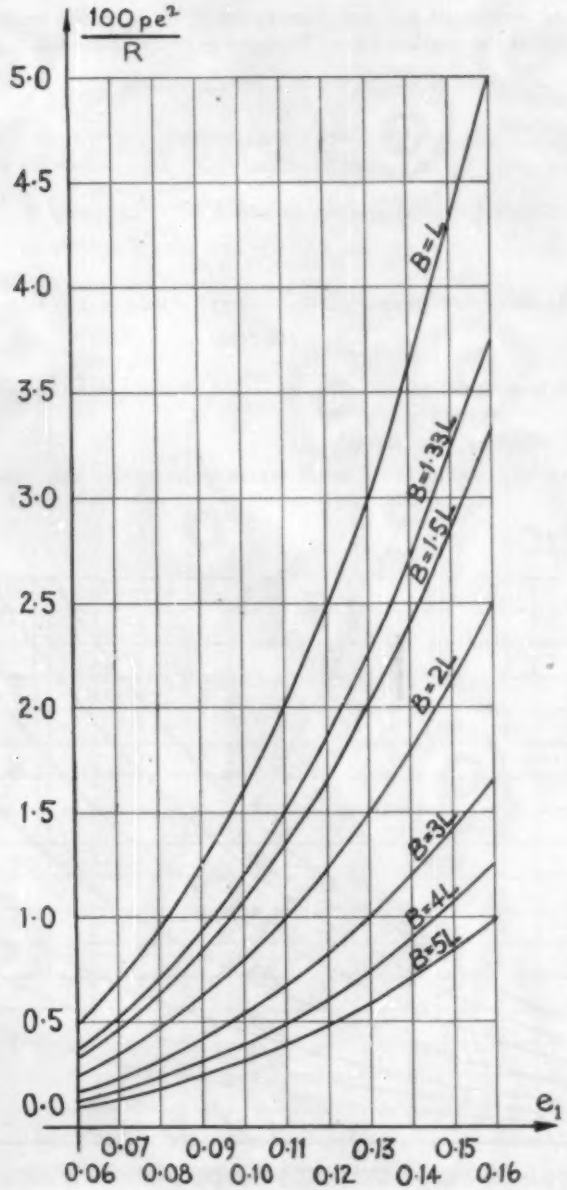
$$R = 218 \text{ tons.}$$

The maximum pressure is $\frac{218}{21{\cdot}75^2} + \frac{109 \times 6}{21{\cdot}75^3} = 0{\cdot}461 + 0{\cdot}064 = 0{\cdot}52$ ton per square foot, which is near enough.

EXAMPLE II.—Although a small eccentricity exists, this case results in



Graph III.


100pe²/R
5·0
4·5
4·0
3·5
3·0
2·5
2·0
1·5
1·0
0·5
0·0
B=L
B=1·33L
B=1·5L
B=2L
B=3L
B=4L
B=5L
e1
0·06
0·07
0·08
0·09
0·10
0·11
0·12
0·13
0·14
0·15
0·16

Graph IV.

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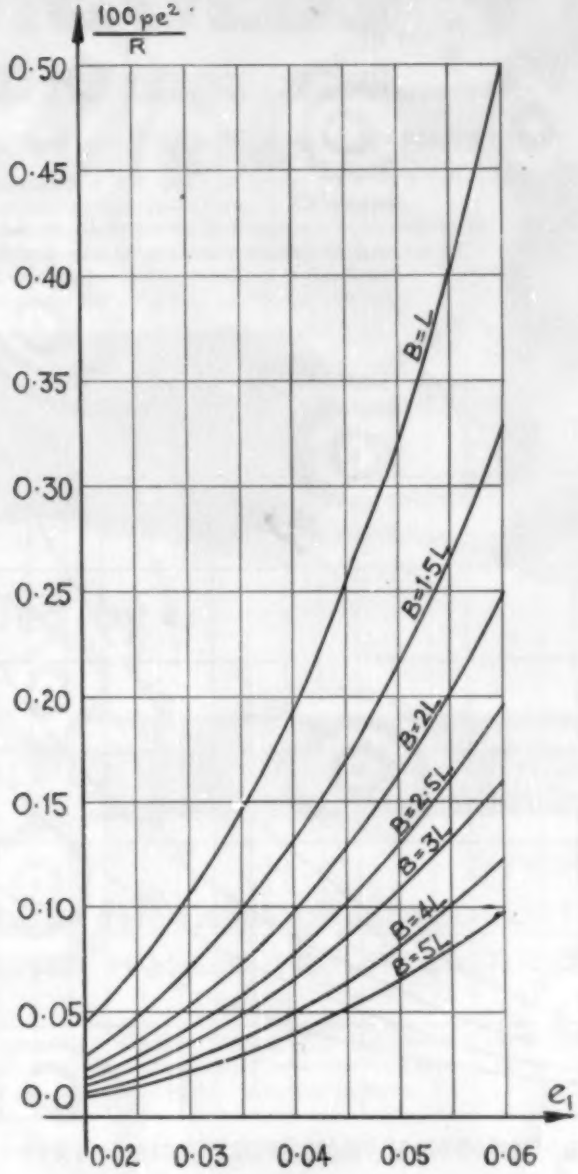


Photograph by courtesy of Air Ministry. Contractors: Messrs. John Laing & Son, Ltd.

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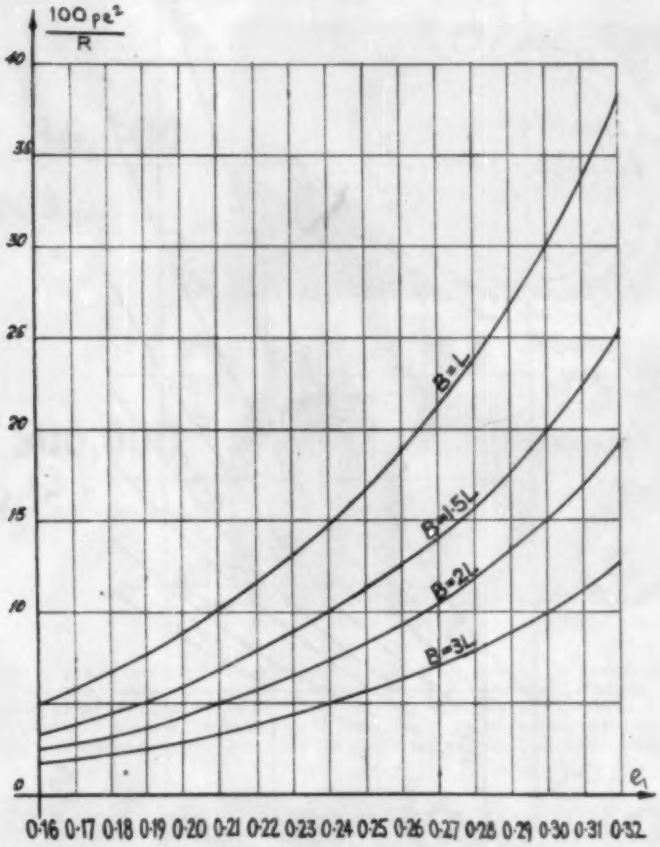
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100pe²/R
0·50
0·45
0·40
0·35
0·30
0·25
0·20
0·15
0·10
0·05
0·0
B=L
B=1·5L
B=2L
B=2·5L
B=3L
B=4L
B=5L
e₁
0·02
0·03
0·04
0·05
0·06

Graph V.

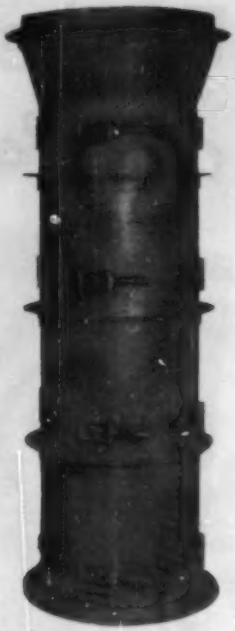
a rectangular base. $\Sigma M = 10$ ft.-tons, $W = 10$ tons, $p = 2$ tons per square foot, $C = 5$ ft. $e = \frac{\Sigma M}{W} = \frac{10}{10} = 1$ ft.

As before, the minimum area of the foundation is $\frac{10}{1{\cdot}75} = 5{\cdot}7$ sq. ft. and the minimum weight of soil and foundation is $\Delta W = 1{\cdot}5$ tons. Therefore $R = 11{\cdot}5$ and $e = \frac{10}{11{\cdot}5} = 0{\cdot}87$ ft. $L = \sqrt{5{\cdot}7} = 2{\cdot}4$ ft., but for a minimum value of $s = 2$. L is equal to or greater than $4e$, or L is equal to or is greater than $4 \times 0{\cdot}87 = 3{\cdot}48$ ft. Therefore L is greater than 2·4 ft. and B will be smaller than L.



Graph VI.

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Choose $L = 2B$ and calculate $\frac{100e^2p}{R} = \frac{100 \times 0{\cdot}87^2 \times 2}{11{\cdot}5} = 13{\cdot}1$. From Graph III, for $L = 2B$, $e_1 = 0{\cdot}175$, and $L = \frac{0{\cdot}87}{0{\cdot}175} = 5$ ft. Make $L = 5$ ft. and $B = 2$ ft. 6 in. To check the maximum pressure,

$\Delta W = 0{\cdot}25 \times 5 \times 2{\cdot}5 = 3{\cdot}15$ tons; $e = \frac{10}{13{\cdot}15} = 0{\cdot}76$ ft.; $\frac{5}{0{\cdot}76} = 6{\cdot}6$ exceeds 6, therefore the maximum pressure is

$$\frac{13{\cdot}15}{12{\cdot}5} + \frac{10 \times 6}{12{\cdot}5 \times 5} = 1{\cdot}05 + 0{\cdot}96 = 2{\cdot}01 \text{ tons per square foot.}$$

If the pressure so obtained is unsatisfactory, then generally all examples of this type can be worked by successive approximation, that is using the last obtained value of L and B to calculate a new value of $\frac{100e^2p}{R}$, and to obtain a new value of e_1 from the graph. Sometimes it will be necessary for L to be greater than B, in which case Graphs IV to VI should be used.

EXAMPLE III.—A raft carrying several columns is acted upon by a total moment of 300 ft.-tons. The minimum dead load is 10 tons acting centrally and the uplift due to the wind is 60 tons; $p = 0{\cdot}5$ ton per square foot and $C = 5$ ft. In accordance with B.S. No. 449, the minimum weight of foundation and soil should be $1{\cdot}5 \times 60 - 10 = 80$ tons; therefore minimum $A = \frac{80}{0{\cdot}25} = 320$ sq. ft. Assume that L equals $2B$, $B = 12{\cdot}75$, $L = 25{\cdot}5$ and $\Delta W = 81{\cdot}25$ tons.

$R = 81{\cdot}25 + 10 - 60 = 31{\cdot}25$ tons, $e = \frac{300}{31{\cdot}25} = 9{\cdot}6$ ft. Since for minimum stability $s = 1{\cdot}5$ and $L = 3 \times 9{\cdot}6 = 28{\cdot}8$ ft., a larger ratio of $\frac{B}{L}$ must be chosen.

Calculate $\frac{100e^2p}{R} = \frac{100 \times 9{\cdot}6^2 \times 0{\cdot}5}{31{\cdot}5} = 145$, and from Graph III, with $L = 4B$, $e_1 = 0{\cdot}311$ and $L = \frac{9{\cdot}6}{0{\cdot}311} = 31$, $\Delta W = 31 \times 8 \times 0{\cdot}25 = 62{\cdot}5$ tons, which is too small.

The size of the base has to be increased to satisfy the condition that the minimum ΔW is 80 tons.

Therefore $B = 8 \times \frac{80}{62{\cdot}5} = 10{\cdot}25$ ft., $e = \frac{300}{30} = 10$ ft.

Check: $\frac{L}{e} = \frac{4 \times 10{\cdot}25}{10} = 4{\cdot}1$, which is less than 6.

Therefore

$$p = \frac{4R}{3(L - 2e)B} = \frac{4 \times 30}{3 \times (31 - 2 \times 10) \times 10{\cdot}25} = 0{\cdot}36 \text{ ton per square foot.}$$

From this example it can be seen that the weight counteracting the uplift decides the size of the base, although the maximum allowable pressure is not reached.

A Machine for Laying Mesh Reinforcement.

THE machine for placing fabric reinforcement shown in the illustrations has been devised by the British Reinforced Concrete Engineering Co., Ltd., in co-operation with Messrs. John Laing & Son, Ltd., for use with large concrete spreading and finishing machines used in the construction of concrete roads and runways. The machine comprises skids or prongs which place the reinforcement to provide the required amount of cover, and travels on the rails provided for the concreting plant. The machine is attached to the front of the concrete spreader, and the skids are withdrawn as the concrete is laid. The machine enables the full depth of concrete to be laid at one time without the use of stirrups or spacers. It is claimed that with the use of this machine a slab 18 ft. wide by 8 in. thick, with the reinforcement 2 in. from the surface, can be laid at the rate of about 10 ft. in three minutes. The mesh is supplied in sheets and wired together at the laps, so that it passes on to the skids as a continuous sheet.



Fig. 1.—Arrangement of Skids.

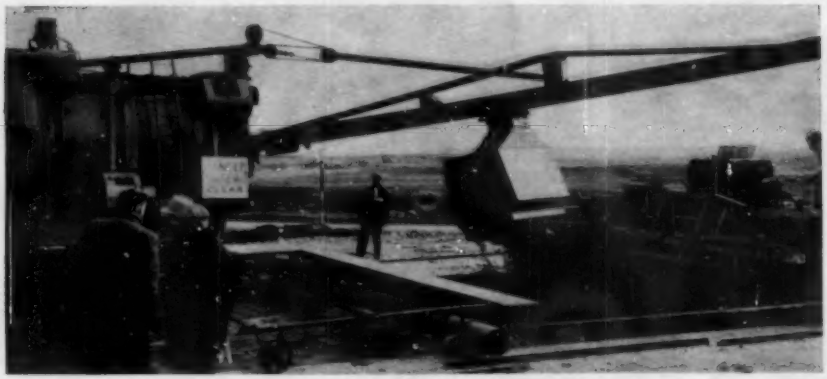


Fig. 2.—The Machine in Use.



Some views of the open-air swimming pool at the Skegness Holiday Camp. By kind permission of Messrs. Butlins Ltd.

waterproofing concrete with Sternson No. 300

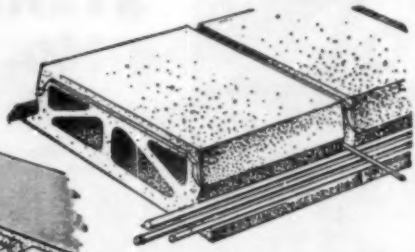
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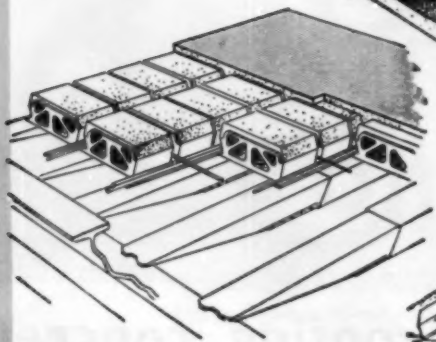
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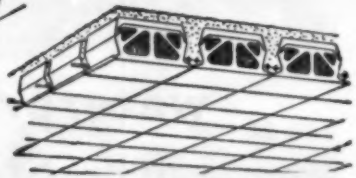
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Sand and Gravel Supplies in Central Scotland.

THE Monopolies and Restrictive Practices Commission's report on the supply of sand and gravel in Central Scotland was published in March (H.M.S.O. Price 4*s.* 6*d.*)

The Commission finds that the members of the Washed Sand and Gravel Association and of the Mid-Scotland Washed Sand and Gravel Association supply more than one-third of the sand and gravel in Central Scotland area and restrict competition in certain ways.

Each Association prescribes minimum ex-pit prices applicable to all members within its " merchanting " area, minimum delivered prices through its " scheduled " area, and minimum haulage rates to places in its " merchanting " area but outside its " scheduled " area. The Commission finds that as a result prices are higher than they might be expected to be under competition, that there is no justification for the artificial maintenance of these prices, that the system operates against the public interest, and that it should be discontinued.

Members' sales are normally invoiced through the secretaries of the associations, who receive the money and pay the producers. The Commission is satisfied that the most important effect of central invoicing is to ensure the observance of the minimum price system, considers that, even in the absence of this system, central invoicing might tend to make for the observance of common prices, and concludes that central invoicing is against the public interest and should be discontinued.

Members of the West Association may not quote for screened unwashed concrete sand, and have an arrangement by which public and local authority schedules for washed sand and gravel are submitted through the secretaries. The Commission considers that both these rules are against the public interest and should be discontinued.

The Associations' " stop-lists " of persons who fail to pay for supplies, the fixed water-content allowances given in the West Association's areas and the methods of weighing prescribed by the Associations are not considered to be against the public interest.

Association merchants bind themselves to purchase all their supplies for delivery in the combined merchanting areas from

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Department of Civil Engineering

Bursaries in Concrete Technology

NOTICE IS HEREBY GIVEN that the election to Bursaries in Concrete Technology, tenable as from October, 1956, will take place in June, 1956.

Candidates must hold a degree in Engineering at the time of taking up the award, and must also have a good knowledge of the theory of structures.

Bursaries are of the value of £460, out of which the College Tuition Fee of £60 has to be paid; the amount may be increased to a maximum of £760, depending on the qualifications and length and nature of industrial experience. The Bursary is for the normal College session extending from October until the following June.

The course will be postgraduate, and Bursars who successfully complete the course will be eligible for the award of the Diploma of the Imperial College (D.I.C.).

Applications must be received on or before 1st June, 1956, by the DEPUTY REGISTRAR, CITY AND GUILDS COLLEGE, Exhibition Road, London, S.W.7, who will, on written request, send full information and application forms.

MODERN CONCRETE PIPE MANUFACTURING METHODS

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A Representative of the Australian proprietor company, itself an internationally known and highly successful pipe manufacturer, will be in U.K. during June next. Those interested to discuss the project with him kindly write to:

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London, W.C.2.

Association members, to observe the minimum prices and other arrangements of the selling scheme, and not to sell screened unwashed concrete sand in the Association areas. In return, they receive a discount and, unlike other merchants, are allowed to buy washed sand and gravel at ex-pit prices. The Commission considers that these arrangements are against the public interest and should be discontinued. In the absence of the common minimum prices and haulage rates, however, the Commission would see no objection to the maintenance by the Associations of a list of merchants, who would accept responsibility for settlement of customers' accounts and make a deposit as a guarantee of financial stability in return for a special discount, provided that producers were free to give to other merchants what discounts they chose.

Fastening Rails to Concrete Sleepers.

A NEW method of fastening rails to concrete sleepers has been installed experimentally in a Class B2 goods line near Syston, Leicestershire, on the London Midland Region of British Railways. A drawing showing the design was given on page 375 of our number for December, 1954, and a photograph is shown in *Fig.* 1.

This new fastening embodies certain features of German practice in conjunction with the use of a grooved rubber pad. The clip is secured by a long screw in a corrugated wooden plug cast in the sleeper. The plug and the shape of the threads of the screw are based on those of the Deutsche Bundesbahn. The plug is of beechwood and is creosoted and may be removed by drilling and shelling and then be replaced by a split plug and strips. The apparently inverted shape of the thread of the galvanised screw provides the best holding power in wood with fibres parallel to the axis of the screw.

The rail lies on a grooved rubber pad 7⅛ in. by 5¼ in. by ¼ in. thick which has a satisfactory load-deflection. The pad takes up inequalities in the surfaces of the underside of the rail and the concrete and by separating the two prevents the latter from being damaged by excessive local pressures. Rubber pads are used at both ends of the clip, and rubber-bonded cork under the head of the screw. The wear is less than between steel surfaces in direct contact and the rubber at the front of the clip prevents direct contact between the clip and the rail; at the same time the friction between the rail and the clip and the resistance to creep of the rail are increased.

The use of synthetic rubber on the back of the clip was considered desirable as it was found from experience of the French type of clip that in some cases the concrete at the back of the clip was spalled. Synthetic rubber has been used in this case so that it will not be affected by oil and dirt collecting in the groove in which the back of the clip rests.



Fig. 1.

The rubber-bonded cork washer between the head of the screw and the clip absorbs much of the upward shock. The clip is 3 in. wide, and the hole through which the screw passes provides adequate clearance so that side thrust from the rail is transmitted through the clip to the concrete. The position of the screw is such that the rail can be released by turning the clip through a right-angle, the rubber pieces being integral with the clip.

The screw, when tightened, exerts a pressure of about 2½ tons on the clip and this, in turn, imposes a pressure of about 1½ tons on the rail. There is one clip on each side of the rail at each sleeper.

MISCELLANEOUS ADVERTISEMENTS.

Situations Wanted, 3d. a word : minimum, 7s. 6d. Situations Vacant, 4d. a word : minimum, 10s. Other miscellaneous advertisements, 4d. a word : 10s. minimum. Displayed advertisements, 30s. per column inch. Box number 1s. extra. The engagement of persons answering these advertisements is subject to the Notification of Vacancies Order, 1952.

Advertisements must reach this office by the 23rd of the month preceding publication.

SITUATIONS VACANT.

SITUATIONS VACANT. Senior reinforced concrete designers wanted by leading reinforced concrete engineers and contractors. Must be fully conversant with Code of Practice, L.C.C. Bye-Laws, and able to design light-framed structures from estimating stage to final details. Five-days' week. Pension scheme. Progressive position. Starting salary from £900 upwards according to ability. This year's holiday arrangements honoured. Juniors also required, similar conditions. Write Box 4172, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Assistant structural engineers required with experience of reinforced concrete design. Experience of precast techniques advantageous. Salary according to experience and qualifications. Apply in writing to TECHNICAL MANAGER, THE SCOTTISH CONSTRUCTION CO., LTD., Sighthill Industrial Estate, Edinburgh.

SITUATION VACANT. Part-time assistance required by Westminster consultants for detailing of concrete bridges. Liberal remuneration for experienced structural draughtsman. Write in confidence, stating age and details of experience, to Box 4256, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATION VACANT. Reinforced concrete design engineer required by specialist reinforcement designer/suppliers. A.M.I.Struct.E. essential, preferably with constructional experience. Permanent superannuated position with scope for advancement. Write or telephone ROK RIVER CO., LTD., St. Richard's House, Eversholt Street, London, N.W.1. Euston 7814.

SITUATION VACANT. Civil engineering draughtsman required for work in London office of large civil engineering contractors. Work of varied nature, with scope for initiative and advancement. Commencing salary £600–£800 depending on experience. Five-days' week and luncheon vouchers. Pension scheme operates. Box 4228, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. J. Mowlem & Co., Ltd., have vacancies in their concrete laboratory for a concrete engineer and an assistant concrete engineer. These positions are permanent and form an excellent opportunity for the right type of man. Salary according to age and experience. For the junior position, previous experience in this type of work is not essential as adequate training will be given. Apply, giving all details in own handwriting, to Box 4253, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

THE TRUSSED CONCRETE STEEL COMPANY LIMITED

ENGINEERING DEPARTMENT

Applications are invited from Reinforced Concrete Designers and Detailers for work in the Company's Head Office in London (near Waterloo Station), and its Birmingham, Glasgow, and Manchester Design Offices. Five-days' week. Pension and Profit Sharing Schemes are in operation. Please apply, giving full details of age, education and previous experience, to the ENGINEERING MANAGER, Truscon House, 35–41 Lower Marsh, London, S.E.1.

SITE AGENTS

Required for Building and Civil Engineering contracts in various parts of the country. Applicants will be expected to have sound supervisory experience on a wide variety of contract work. Professional qualifications are required for those seeking senior Civil Engineering appointments. Full mobility essential. Age 30-50. Salary commensurate with experience and qualifications.

The company has an established policy of employment security, and men who prove themselves can expect advancement and permanent pensioned employment.

Applications in writing to :

PERSONNEL MANAGER (S.A.5.), JOHN LAING AND SON, LIMITED, Building and Civil Engineering Contractors, London, N.W.7.

SITUATION VACANT. Draughtsman required by consulting engineers, Westminster, for reinforced concrete bridge work. Salary up to £800 per annum according to ability. Interesting work and excellent prospects. This year's holiday arrangements honoured. Write, stating age and details of experience, to Box 4257, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. 'TWISTREL' REINFORCEMENT LTD., have vacancies in their Birmingham and Glasgow drawing offices for reinforced concrete designers and detailers. Five-days' week. Pension scheme. Lunching facilities. Apply in writing, stating experience and salary required, to CHIEF ENGINEER at either Alma Street, Smethwick, 40, Staffs., or 19 St. Vincent Place, Glasgow, C.1.

SITUATIONS VACANT. Reinforced concrete draughtsmen required in civil engineering department of THE COPPEE CO. (G.B.), LTD., 140 Piccadilly, London, W.1. Colliery structures of interesting and varied character. Some experience necessary, and knowledge of design advantageous. Staff pension scheme. Five-days' week.

SITUATIONS VACANT. Draughtsmen who are anxious to obtain design experience are invited to apply for vacant positions on the permanent staff of a firm of specialists in reinforced concrete and hollow tile floors. Working conditions are good, and a non-contributory pension scheme is in operation. Write, giving the fullest information, including salary required, to Box 4254, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Reinforced concrete detailers required with good experience of foundations and framed structures. Five-days' week, pension scheme and luncheon vouchers. Apply to E. J. COOK & Co. (ENGINEERS), LTD., 54 South Side, Clapham Common, London, S.W.4.

SITUATIONS VACANT. KAYLOR & PICK, Consulting Engineers, require in their London office, senior and junior detailers and draughtsmen for reinforced concrete work. Positions offered are permanent, and the work is varied and interesting. There is scope for advancement for men with ambition. Five-days' week. Apply to 42 Ferncroft Avenue, London, N.W.3.

LONDON COUNTY COUNCIL

ARCHITECT'S DEPARTMENT

Vacancies for Engineering Assistants (up to £818) and Engineer Grade III (up to £987) in the Structural Engineering Division. Work includes steelwork and reinforced concrete design and detailing for Council's buildings. Particulars and application forms from ARCHITECT (AR/EK/SE/3), The County Hall, London, S.E.1. (1276.)

(Continued on next page).

MISCELLANEOUS ADVERTISEMENTS.

(Continued from previous page.)

LONDON COUNTY COUNCIL

ARCHITECT'S DEPARTMENT

As a result of regrading of positions and salary increases, there are opportunities in the Architect's Department for STRUCTURAL ENGINEERS: Grade II (£987–£1,184); Grade III (£775–£987); and Assistants (£620–£818). There is a full programme of interesting work. Promotion is by merit. Starting points in the various scales may be according to qualifications and experience. The department is able to offer experience of the highest value and, to those interested, good prospects of a permanent career in the public service.

(1) *Structural Engineering Division*

A few good designers required at Grade II level, also engineers Grade III and a few resident engineers Grade III. Vacancies for a number of engineering assistants.

(2) *District Surveyors' Service*

Vacancies for structural engineers at Grade II, Grade III, and assistant level.

Application forms and further information obtainable from The ARCHITECT (AR/EK/DSE/2), County Hall, London, S.E.1. (385)

SITUATION VACANT. Civil engineering draughtsman required by consulting engineers in Victoria district. Limited experience accepted if good progress made with ONC/HNC studies. Details, please, to BOX 4262, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1

SITUATIONS VACANT. Reinforced concrete designers and draughtsmen required for varied and interesting work for heavy foundations and structural contracts. Permanent positions with opportunities for advancement. Good salary, and entry into superannuation scheme may be arranged after twelve months' service. Applicants should write, stating age, qualifications and experience, to MITCHELL CONSTRUCTION CO., Wharf Works, Peterborough.

SITUATIONS VACANT. JENKINS & POTTER, 66 Victoria Street, London, S.W.1, require one senior and one junior assistant experienced in reinforced concrete. Five-days' week. Salary £600 to £1,200. Telephone Tate Gallery 9333 for appointment.

Opportunity for Senior Reinforced Concrete Designers...

to join the staff of

BRC

There are vacancies for competent designers at our Head Office and at most of our design offices in

LONDON · BRISTOL · LEEDS · LIVERPOOL

NEWCASTLE · GLASGOW · DUBLIN

THE BRITISH REINFORCED CONCRETE ENGINEERING CO. LTD., STAFFORD

Chief Engineer: A.P. Mason, B.Sc., M.I.C.E., M.I.Struct.E., M.ASCE

M-W.776

SITUATION VACANT. Air Ministry Works Designs Branch requires in London, structural engineering designer/draughtsmen for reinforced concrete or structural steelwork, with sound technical training and several years' varied experience in design/detailing of: (a) Reinforced concrete construction for all types of buildings, or (b) Steel-framed sheds, warehouses and similar buildings. Salaries up to £850 per annum. Starting pay dependent upon age, qualifications, and experience. Paid overtime. Long-term possibilities with promotion and pensionable prospects. Normally natural born British subjects. Write, stating age, qualifications, employment details, including type of work done, to any Employment Exchange, quoting Order No. Borough 1001.

SITUATION VACANT. Structural designer-draughtsman required by the design department of Kodak, Ltd. Should be experienced in the design of structures in reinforced concrete and structural steelwork and the preparation of working drawings. Minimum qualification, Higher National Certificate in Structural Engineering or equivalent. The position can be regarded as permanent and progressive. The Company operates a non-contributory pension and insurance plan. Apply by letter to the PERSONNEL DEPARTMENT, KODAK, LTD. (Factories), Wealdstone, Middx.

SITUATIONS VACANT. Junior engineers and draughtsmen for work on steel and reinforced and prestressed concrete work and foundations. Salaries up to £900 per annum. KINNEAR & GORDON, Consulting Engineers, 54 Manor Place, Edinburgh, 3.

SITUATIONS VACANT. TAYLOR WOODROW CONSTRUCTION, LTD., require senior and assistant technical staff in the following categories:

Structural Design Engineers with reinforced concrete experience, for Head Office.

Site Civil Engineers. Interesting and progressive positions for the right men. Well-paid and pensionable posts. Write, giving full details, which will be treated confidentially, to M.D. Engineer, Ruislip Road, Southall, Middlesex.

PORT OF LONDON AUTHORITY

The Port of London Authority have vacancies in their Drawing Office at Head Office, Trinity Square, London E.C.3, in the following grades:

1. *Senior Technical Assistant*
for reinforced concrete and steelwork design.

Salary Scale:
"A" £920 by varying increments to £1,075 per annum.
"B" £700 by varying increments to £890 per annum.

Qualifications required:
For "A" Corporate membership of the Institution of Civil or Structural Engineers. Assistants joining in Section "B" of the grade will be considered for promotion to Section "A" when they have become corporate members of the Institution of Civil or Structural Engineers.
For "B" Higher National Certificate or equivalent in appropriate subjects.

2. *Leading Technical Assistant*
for reinforced concrete and steelwork design and detailing under supervision.

Salary Scale:
£600 by £25 to £725 per annum.
There is an increment bar at £650 per annum, progress beyond which will depend on service, ability and qualifications.

Qualifications required:
Ordinary National Certificate or equivalent in appropriate subjects.
Assistants obtaining Higher National Certificate will be considered for promotion to Senior Technical Assistant.

COMMENCING SALARY in all cases according to experience.

Applications giving full details of experience, age, qualifications and position applied for, should be addressed to the ESTABLISHMENT OFFICER, Port of London Authority, Trinity Square, London, E.C.3.

JOHN LAING AND SON LIMITED

invite applications for the following technical staff vacancies:

STRUCTURAL DESIGN ENGINEERS, preferably qualified, with sufficient design experience to undertake work on their own responsibility.

STRUCTURAL DESIGNER/DETAILERS AND DRAUGHTSMEN with good design office experience.

The appointments are mainly at Head Office, and a wide field of interesting work is covered—particularly suitable for those studying for a qualification. The posts are permanent and pensionable. Five-days' week. Staff Canteen. Sports Club facilities. Please apply in writing, stating age, qualifications and experience, to PERSONNEL MANAGER (S.D.5.), JOHN LAING AND SON LIMITED, Building and Civil Engineering Contractors, Page Street, London, N.W.7.

SITUATION VACANT. The Trussed Concrete Steel Co Ltd., 35-41 Lower Marsh, London, S.E.1, require an experienced engineer with sound knowledge of building and reinforced concrete work, to act as service engineer to advise contractors carrying out reinforced concrete constructions. Applicants should be preferably A.M.I.Struct.E. or possess similar qualifications, and not be older than 50 years of age. The position would be based in London, but successful applicant would be expected to visit sites throughout the country. Reply, giving details of experience, and salary required, to the TECHNICAL DIRECTOR at the above address.

SITUATION VACANT. Design assistant (general construction) required by East African Railways & Harbours Civil Engineering Department on contract for tour of 36–48 months. Consolidated salary up to £1,700 per annum. Gratuity at 10 per cent. of total salary drawn. Free passages. Liberal leave on full salary. Candidates must be equally experienced in steel and reinforced concrete structural design. Write to the CROWN AGENTS, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2B/40744/CAR.

SITUATIONS VACANT. Reinforced concrete designers (senior and junior) required by consulting engineers for varied and interesting building frames and industrial structures. Good prospects. Five-days' week. Lunch vouchers. Apply, with details of experience, etc., to JOHN FARQUHARSON & PARTNERS, Chartered Structural Engineers, 34 Queen Anne Street, London, W.1. Langham 6081.

SITUATIONS VACANT. Site engineers required for reinforced concrete framed structures in London area and provinces. Applicants must be over 35 years of age, and thoroughly experienced in all classes of reinforced concrete work. Good salaries offered to the right men. Apply in writing to J. H. COOMBS & PARTNERS, Consulting Engineers, Thames Corner, Sunbury-on-Thames, Middlesex.

SITUATIONS VACANT. Designer-detailers and detailers experienced in reinforced concrete required for London professional office. Knowledge of steelwork an advantage but not essential. The work is varied and offers scope for initiative and advancement. Opportunity for site visits, and possibility of joining resident engineer's staff later on. Five-days' week. Apply, stating experience and salary required, to FARMER & DARK, Romney House, Tufton Street, London, S.W.1.

SITUATION VACANT. Structural steel design assistant, with some general reinforced concrete experience, required by Westminster consulting engineers. Age-range 28–40. Varied work includes bridges, caissons and special structures. Salary not quoted as this will be based on experience. Post is permanent. Particulars, please, to BOX 4266, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

DESIGNER DRAUGHTSMAN

Civil Engineering Contractors require Designer-Draughtsman for interesting work at Head Office in York, on Reinforced Concrete and temporary works for larger type contracts. Chronological details of experience, and salary required, to BOX 4268, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

WORKS MANAGER
SOUTHERN RHODESIA

A rapidly-developing company in Gwelo, specialising in production of precast prestressed Concrete structural units, require

A WORKS MANAGER.

Applicants must have had previous experience and be keen and ready to assume full responsibility for the entire administration of production. The labour force is entirely African, at present approximately 100, with European charge-hands. Previous experience of handling native labour is an advantage but not essential.
Commencing salary £90 per month, rising by annual increments to £110 on the basis of a 5 years' contract.
Air passage paid to successful applicant. Good leave. Profit-sharing scheme.
Write, giving full details of education, age, personal circumstances, qualifications, and career to

SUMNER HARKER & CO., LTD.,
196 Deansgate,
MANCHESTER.

SITUATIONS VACANT. Engineers required by PETER LIND & CO., LTD., Romney House, Tufton Street, Westminster, S.W.1. Designers and assistant site engineers with two to three years' experience in reinforced concrete and general civil engineering works. Apply in writing only, giving age and full description of experience and stating salary required.

SITUATION VACANT. Estimator required by PETER LIND & CO. LTD., Romney House, Tufton Street, Westminster, S.W.1. Candidates must have good all-round experience in civil engineering work, more particularly the design of temporary works such as stagings, cofferdams, etc. Apply in writing only, giving age and full description of experience and stating salary required.

SITUATIONS VACANT. Reinforced concrete detailers required in London head office for a wide variety of work. Five-days' week. Apply to GEORGE WIMPEY & CO., LTD. (W. Crozier), 27 Hammersmith Grove, London, W.6. Riverside 8611.

SITUATIONS VACANT. Experienced reinforced concrete designers and detailers required urgently. Salary according to qualifications and experience. Pension scheme. Five-days' week. Paid overtime. Write, stating when free, age, qualifications, and experience. Salary range £850-£1200 per annum. BRIAN COLQUHOUN & PARTNERS, 18 Upper Grosvenor Street, London, W.1.

SITUATION VACANT. Works engineer required as assistant works manager for spun concrete pipe works. Qualifications: good sound knowledge of machinery maintenance and mechanical engineering, organising ability, and ability to control labour. Knowledge of plant layout and heavy-duty machinery essential. Preference for an applicant under the age of 35. Works located in Leicestershire. Please apply to MANAGING DIRECTOR, JOHN ELLIS & SONS, LTD., 21 New Walk, Leicester, stating qualifications and salary required.

SITUATIONS VACANT. Experienced structural steelwork designers and detailers required urgently. Salary according to qualifications and experience. Pension scheme. Five-days' week. Paid overtime. Write, stating when free, age, qualifications and experience. Salary range £850-£1200 per annum. BRIAN COLQUHOUN & PARTNERS, 18 Upper Grosvenor Street, London, W.1.

SITUATION VACANT. Designer-draughtsman required for London office of well-known reinforced concrete engineering contractors. Experience in reinforced concrete frames, floors, roofs, and staircase construction essential. Progressive post, pension scheme, and five-days' week. Write fully, stating salary required, to BOX 4270, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

(*Continued on next page*).

MISCELLANEOUS ADVERTISEMENTS.

(*Continued from previous page.*)

SITUATIONS VACANT. A permanent career in an oil company exists for civil engineering draughtsmen (25–35 years of age) who have experience of reinforced concrete structures and foundations. Applicants should have a good basic training and should be qualified up to O.N.C. level. The offices, which are situated in the West End of London, have a restaurant and snack bar. Employees receive three weeks' leave annually. Full details will be supplied to those applicants who are interviewed. Write, quoting No. 629, to BOX 9910, CHARLES BARKER & SONS, LTD., 31 Budge Row, London, E.C.4.

SITUATION VACANT. Well-known company operating in the London area and Northern England is desirous of expanding its concrete products division, and seeks a gentleman well known in the industry who is capable of establishing satisfactory relations with architects and engineers engaged in industrial and other building development. The man will necessarily have drive, initiative, a good personality, and be capable of developing new business, and must have sound technical knowledge of the industry. Preference given to applicant who has an established connection in the London area and surrounding Counties. The appointment will carry an appropriate salary and expenses, and is pensionable. Apply, with full information, to BOX 4269, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Reinforced concrete designer-draughtsmen and detailers required for work on a variety of structures, including shell roofs. Apply, giving full particulars, to JAMES E. WARDROPPER, Consulting Engineer, 116 Victoria Street, London, S.W.1.

SITUATION VACANT. Reinforced concrete designer required by HOLST & CO., LTD., for interesting and varied work in all types of structures. Bonus and non-contributory pension scheme. Write, giving full particulars, to 10 Waddington Street, Durham City. Telephone: Durham 4353.

SITUATIONS VACANT. Reinforced concrete designers and draughtsmen required for detailing both in situ and precast concrete, single and multi-story buildings. Ideal conditions in new drawing office at Hemel Hempstead. House available. Three weeks' holiday per year. Bonus and pension scheme. Five-days' week. Write for interview, or telephone Boxmoor 3810. THE LONDON FERRO-CONCRETE CO., LTD., Maxted Road, Hemel Hempstead.

SITUATIONS VACANT. Reinforced concrete assistants required in consulting engineers' office. Two years' experience minimum. Good opportunity to obtain varied experience at office and site. Every consideration given to good draughtsmen keen to improve. Write or telephone A. D. BOGEN & ASSOCIATES, 144 High Holborn, London, W.C.1. Chancery 6630.

MINISTRY OF WORKS

Assistant CIVIL ENGINEERS required on various sites in the United Kingdom. Candidates must be British by birth and have passed, or have exception from, Parts I and II of A.M.I.C.E. examination. Should have site experience.

Salary between £732 at age 25 and £1,153 per annum. Prospects of promotion and permanency. Hostel accommodation may be available for single men.

State age and full details to: CHIEF WORKS ENGINEER (E), MINISTRY OF WORKS, Cleland House, Page St., London, S.W.1.

SITUATIONS WANTED.

SITUATION WANTED. Position as resident engineer or site engineer required on a civil engineering contract in the London area. BOX 4261, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATION WANTED. Active young man (23), completed National Service, seeks position of responsibility with precast-prestressed concrete manufacturers situated in London area or Home Counties, where hard work and ability are rewarded by reasonable salary and prospects. Three years' experience in detailing and estimating. Studying for a professional degree. Assistance in accommodation would be required. BOX 4265, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATION WANTED. Graduated civil engineer, 25 years old, Israeli subject, wishes employment in design office, preferably for statical calculations and/or prestressed concrete. BOX 4271, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

PARTNERSHIP.

PARTNERSHIP WANTED. Engineer, B.Sc., with eleven years' responsible experience, seeks partnership in established civil engineering or structural consultant's office. Capital available. BOX 4263, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

PATENT.

PATENT. The Proprietors of British Patent No. 675,666 for "Improvements in or relating to means for moulding concrete blocks and a method of moulding concrete blocks therewith," desire to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. Further particulars may be obtained from MARKS & CLERK, 57 & 58, Lincoln's Inn Fields, London, W.C.2.

FOR SALE.

FOR SALE. Steel fencing stakes, chain link, etc. E. STEPHENS & SON, LTD., Bath Street, London, E.C.1. Clerkenwell 1731.

FOR SALE. Steel tubes and fittings. Sizes to 10 in. E. STEPHENS & SON, LTD., Bath Street, London, E.C.1. Clerkenwell 1731.

FOR SALE. Steel guttering, ironwork, and sheet metal work. E. STEPHENS & SON, LTD., Bath Street, Clerkenwell, London, E.C.1. Clerkenwell 1731.

FOR SALE. Reinforcement. Second-hand bars, rods, F.B. rails, etc. Inquiries invited. BOX 4267, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

FOR SALE. Excellent bargain. Complete crushing and screening plant, with automatic-return reject feeds, complete with 3-phase motors. Quantity of conveyor belting 24 in. and 36 in. wide. Can be seen operating in London area. BOX 4264, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

FOR HIRE.

FOR HIRE. Lattice steel erection masts (light and heavy), 30 ft. to 150 ft. high, for immediate hire. BELLMAN'S, 21 Hobart House, Grosvenor Place, London, S.W.1.



M-W.791

STONE ★ COURT AGGREGATES



General View of Plant at Rickmansworth.

ONE OF OUR MODERN CONCRETE AGGREGATES PLANTS

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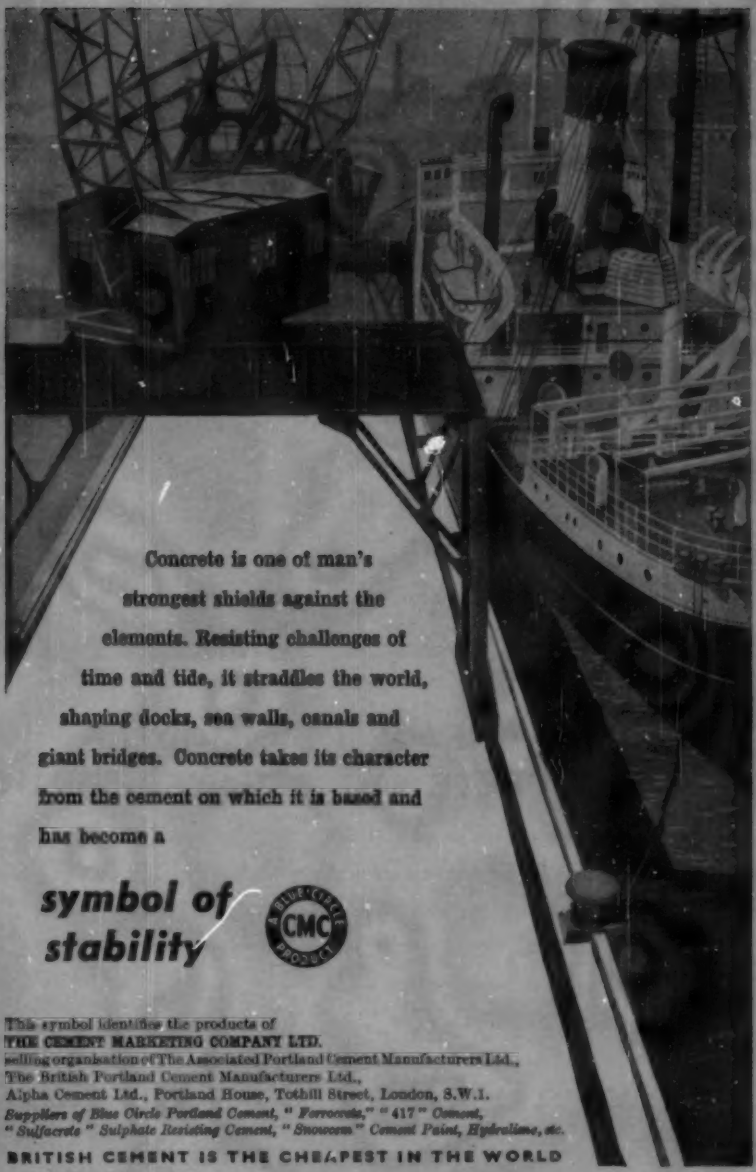
Our products include Washed Sharp Sand, all sizes of shingles, from 3/16" up to 2", either crushed or natural.

Special Specifications made to order.

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